BRITISH ASSOCIATION NUMBER

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XI. No. 129. SEPTEMBER, 1930. PRICE 1s. NET

BRISTOL UNIVERSITY.
Headquarters of the British Association Meeting.

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Vol. XI. No. 129. SEPTEMBER, 1930. PRICE 1s. NET

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Editorial Notes.

We are fortunate in publishing this month an important review of the British Association's recent history, written specially for *Discovery* by Mr. O. J. R. Howarth. The article brings the history of this great organization up to date, and completes the record of a century's endeavours. Founded in 1831, the British Association for the Advancement of Science has grown steadily in influence, and enters its centenary year in a stronger position than ever. In earlier years the meetings were regarded with open contempt, and only after long and patient efforts on the part of pioneer members was the Association publicly recognized. With just pride the Secretary draws attention to the fact that, almost alone among societies of the kind, it has not raised the original subscription of one pound, instituted a hundred years ago. On the contrary, by concessions granted to students and through other causes, the cost of membership has actually been lowered. As a result the gross receipts are smaller than formerly in proportion to the attendance at meetings, and the continued progress is therefore all the more remarkable. The discussions that will take place at Bristol this month include many subjects of interest to readers of *Discovery*, and we take the opportunity as in previous years to publish articles related to the programme. The new President, Professor F. O. Bower, has had a distinguished career, and with his permission we publish a biographical sketch, written by a former colleague. Visitors to Bristol will find much interest in the Vice-Chancellor's description of the University, and in the article on tobacco—an industry long associated with the city. Among the other subjects attention may be drawn to the plea for a national Folk Museum, advanced by Mr. E. N. Fallaize. It has just been announced that the Government is considering plans for such an institution, towards which a sum of £50,000 has been promised. We shall publish a report of the meeting in our next number

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This summer the British School at Athens has been excavating the site of the Heraeum, which was situated on a headland north of Corinth. Describing the results in *The Times*, Dr. Humfry Payne states that the occupation of the Heraeum goes back to the latter part of the eighth century B.C., from which time onwards it seems to have played a considerable part in the history of Corinth. The district provided valuable grazing and cultivable ground, and must have been an important source of timber for ship-building. It was also clearly of great strategic importance, being strongly fortified like the neighbouring towns of Peiraion and Oenoe. The excavations have revealed a temple in a field near the harbour, but though of considerable interest it is evidently not the famous Heraeum. The most striking discoveries were made in a building nearby—a "Treasury" in which the votives to Hera were stored. Most of the objects were fragments of pottery, dating from 750 to 200 B.C., the best examples being Protocorinthian (seventh century). A remarkable specimen of this period is the lid of a box decorated with a scene from wild life. The design is carried out in a simple but effective style, perfectly suited to the subject matter. The Treasury also contained some imported objects, mostly of Egyptian origin. It has long been thought that Corinth had close relations with Egypt, and these discoveries seem to provide concrete evidence.

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Excavations in Rhodesia, also reported in *The Times*, have thrown new light on the antiquity of

metallurgy in southern Africa. For two years past an Italian expedition has been working at various sites, under the command of Captain Yatti, and the metal discoveries were made this summer in the Mumbwa Caves. These are distant 130 miles from Broken Hill, the scene of the discovery of Rhodesian Man about ten years ago. In front of the cavern large quantities of slag and iron ore were scattered, the whole providing the first example of the kind which can be dated in a strictly archaeological manner. It now appears that a knowledge of smelting existed in Rhodesia about 3,000 years before the arrival of the Bantus, whose mining activities are associated with the famous ruins at Zimbabwe.

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While our August number was in the press we received a visit from Sir Hubert Wilkins. In discussing the report of his submarine expedition to the North Pole next year, the explorer told us some interesting details of his plans. The proposal is to travel on the surface where open sea is available, submerging when ice is encountered. In order to discover the extent of the ice areas, a captive balloon will be used to take aerial photographs, which will provide a map for navigation purposes. Whether it will be possible to prospect the ground conditions adequately in this way must await further tests, but Sir Hubert is confident that the method will prove successful. A thorough acquaintance with Arctic conditions is, of course, an important factor, but an explorer of Sir Hubert's experience will tackle the problem from a standpoint that is thoroughly scientific. A complaint was expressed that British financiers had failed to support the expedition, and that funds are accordingly being raised in America. Many people will share his wish that a British backing could be provided, but owing to high taxation there is less money than ever available for adventures of this character.

* * * * *

Preliminary plans are announced for the Faraday celebrations to be held in London next year. In the spring of 1831 the electrical pioneer began his experiments on the induction of electric currents ; and on 29th August he made the discovery in which lies the origin of the dynamo, and the starting point of the utilization of electric power. On that day, as his diary shows, he wound two coils of wire on to opposite sides of a soft iron ring, connecting one coil to a battery and the other to a galvanometer : at "make" and "break" of the battery circuit he observed deflections of the galvanometer connected in the other circuit. This simple experiment has given rise, in less than a hundred years, to the science of electrical engineering and to the great electrical industry, in all its phases as we know it to-day. In arranging the celebrations, it is fitting that the lead should be taken by the Royal Institution, for it was to the well-known premises in Albemarle Street that Faraday came in 1813, a youth of twenty-two, to become assistant to Sir Humphry Davy who was then the professor of chemistry. Later he succeeded Davy, and there gave his famous lectures. In the centenary programme the Royal Institution will have the assistance of the Institution of Electrical Engineers, and will also cooperate with the Royal Society and the British Association.

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Throughout his life Faraday kept a careful diary, written in his own hand, of all his experimental work. On his death these "Experimental Notes" were bequeathed to the Royal Institution, and for over sixty years they have been its most treasured possession. Although the philosopher himself made extensive use of it in the preparation of his published works, the diary itself has never been published, and to mark the forthcoming centenary the managers of the Royal Institution have resolved to publish it in full. The work is now in course of preparation, and it will be issued on their behalf by Messrs. G. Bell & Sons. It is intended to complete the work in about eight volumes, of which two or more will be ready by September, 1931.

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The police at Brighton are making experiments with portable wireless receivers. The plan is to equip policemen with "pocket sets" by which they can keep in touch with headquarters while out on patrol. A special committee of police chiefs is considering the scheme in conjunction with wireless and motor experts, and if the preliminary tests are successful it is hoped to employ wireless control throughout the country. It is reported that the set can be carried in a breast pocket, and weighs no more than a policeman's torch. Miniature headphones and a "buzzer" are also part of the equipment. A message broadcast from the police station would reach every constable within the city radius. Presumably a special wave-length would have to be employed, but we foresee an amusing situation when a "crook" (or a practical joker) discovers the secret and sends out a false alarm !

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It is announced that the sixth annual Norman Lockyer Lecture will be given by Professor Sir William Pope, F.R.S., on 13th November, at 4.30 p.m., in the Goldsmiths' Hall. The president of the British Science Guild, Sir Samuel Hoare, will take the chair at the lecture, the title of which will be published later.

The British Association : 1920-1930.

By O. J. R. Howarth, M.A., O.B.E.

Secretary of the British Association for the Advancement of Science.

The following review of events during the past ten years forms an interesting addition to Mr. Howarth's history of the British Association (" A Retrospect : 1831-1921 *"), and brings the record of its activities up to date. The period has included the Presidency of the Prince of Wales and the grant of a Royal Charter.*

THE last decade of the British Association's first century has been notable in its history. The Prince of Wales honoured it by accepting its presidency in 1926. Over three thousand members assembled for the meeting in Oxford that year. The sole occasion for regret then was that only half of them could see, as well as hear, the presidential address delivered in the Sheldonian Theatre, that famous little building of which the design so curiously—and for a university auditorium, so properly—induces a spirit of intimacy between speakers and audience. In it the members who were fortunate enough to secure admission, appearing in every sort of academic costume, imperial and foreign, staged a spectacle such as the Association has probably never before displayed ; alas, that no artist was present to record it. Those who could not see the address delivered could at least hear it, for it was relayed to two other halls. Incidentally, it seems likely that a similar subterfuge of science will be needed at the centenary meeting next year, for the Central Hall at Westminster can scarcely be expected to accommodate the total attendance, and the Albert Hall, which it had been intended to put to the use for which it was designed, will not be available. Relaying, it may be added, was first put into practice for the Association at the Liverpool meeting in 1923, for Sir Ernest Rutherford's address. That also was the first to be broadcast, and we were told as a matter for congratulation that it was well heard in Switzerland. And this but seven years ago !

Darwin's House.

The Association received its Royal Charter of incorporation in 1928, a gift implying new responsibilities, and enabling one, in particular, to be assumed. For the Association, unchartered and having no legal entity, could not have accepted the gift, and the signal honour of the custodianship, of Darwin's house at Down. The writer of these lines will not easily forget the moment when, following upon Sir Arthur Keith's appeal at the Leeds Meeting in 1927, it fell to him to open a telegram which was delivered in the office on the following morning. In it Mr. George Buckston Browne, answering the appeal, announced his intention of buying the property, and it is thanks to him that, in the words of the Council's report, " the Association now possesses in custody for the nation Down House, where Darwin thought and worked for forty years, and died in 1882. Mr. Buckston Browne, besides vesting in the Association the sum of £20,000 for the maintenance of the property, has fully restored the house (an extensive and urgent work), and has placed the ground floor in a condition appropriate to exhibition to the public ; in particular, the Old Study, where the ' Origin of Species ' was written, has been brought as nearly as possible to an exact replica of its condition in Darwin's time, with much of the original furnishing and copies of, or close approximations to, the rest. Under Mr. Buckston Browne's inspiration, members of Darwin's family, and others, have liberally given original furniture and other objects of interest for preservation in the house. The restoration of the gardens and the Sand Walk is also in progress."

11,000 Visitors.

That the house, curiously difficult of access as it is for a place so near to London, should have been visited by 11,000 people during the first year of its opening, is sufficient justification for its preservation as a memorial ; but that the place should be associated with some form of scientific work is an objective of which the attainment would crown the enterprise.

The Association, at the outbreak of the Great War in 1914, was meeting in Australia, and the meeting was carried through with little material alteration of programme. According to legends which (as about other topics of the time) sprang up like mushrooms, the meeting was abandoned and one of the steamers conveying a number of the members homeward was sunk by the " Emden." Neither of these things happened.

Meetings were held also in 1915 and 1916, but with growing difficulty, and by 1917 it was apparent that

business could not be carried on as usual. Therefore in that and the following year no annual meetings in the accustomed sense took place. In 1919 the series was renewed, and in a new place, where the Association had never met before—Bournemouth.

Anyone who judged solely upon the attendance of members at that meeting and the next, in Cardiff, might have feared that the Association had in some measure lost its hold. And so much was actually asserted; but those who did this forgot that these two meetings, as it chanced, had been held in localities where meetings, however successful otherwise, have been always numerically small. Scottish meetings, however, had always been large, and, true to type, the Edinburgh meeting in 1921 went far to restore the balance. Even the faith of the permanent executive had been insufficiently strong, and probably for the first time (and, it may be hoped, for the last) an insufficient number of membership tickets was provided for this occasion. Since that year, attendances have been on the whole satisfactory, and out of the four largest meetings recorded in Great Britain, two have occurred in the past decade—at Liverpool in 1923 and at Oxford in 1926.

Membership and Influence.

This subject is worth consideration from the administrative standpoint, for the Association must depend upon its membership—not merely financially but for the maintenance of its influence, which may be claimed to have definitely increased in the period under review. That dependence introduces certain problems. Thus: (1) the Association has not raised the ordinary subscription of £1 for attendance at an annual meeting, which was fixed in 1831. There cannot be many institutions in a position to make this assertion; but the Association has gone further by introducing a half-rate for students. And (2) the proportion which the gross receipts from membership subscriptions bears to the total attendance at any meeting is actually smaller than it was, owing to the above and certain other adjustments. But (3) the Association, organized as it is, dependent for the bulk of its membership upon one meeting at a different place every year, and offering only to the most ardent "cultivators of science" any other inducement to permanent membership, is subject to a variable limitation of membership in any one year.

There is a measure of geographical control over membership, as has been suggested already; moreover, there must be a limitation of accommodation with comfort, varying according to the size and character of the town where a meeting is held. It is not suggested that this latter limitation has ever been actually reached in any place where the Association has met, but it has been within sight more than once. And there are places where the Association has met in the past, which probably would hesitate now to invite it for a meeting, on the ground that they could no longer meet its requirements. It would be far worse if the Association were compelled to refuse an invitation from any place on the ground that a sufficient return in subscriptions could not be expected. That, again, has not happened. But either it must have happened, or the subscriptions must have been increased (with the almost certain result of a fall in membership), or some of the Association's activities (such as the financial support of research) must have been reduced, if the Association since the War had not been made the recipient of munificent donations, for general purposes, from Sir Charles Parsons and Sir Alfred Yarrow. To these should be added, among other benefactions, a substantial sum subscribed by old life members by way of addition to their original composition fees, and also monetary help afforded by the Department of Scientific and Industrial Research to some of the researches undertaken immediately after the War. Among these researches (though not one of those so assisted) probably none was of higher public importance than that which resulted in the publication of a remarkable series of studies of British finance and labour.

Thanks to the generous helpers named, the finances of the Association have for the moment been stabilized. For the moment; but the Association has new commitments (notably in relation to Down House, and to the Centenary celebration next year) and possibilities of activity in new directions at the beginning of its second century which must depend for their full fruition upon financial considerations. If, therefore, it should be decided to appeal for further endowment, the work of the last decade of the Association's first century (not to mention that century's full record) may be taken to offer a measure of justification.

Overseas Meetings.

In the decade under review, there have been two meetings overseas, in Toronto (1924) and in South Africa (1929). It is a happy feature of the post-war period that closer relations have been established between the British and the American Associations for the Advancement of Science. That Association has been frequently represented at our meetings; to its own (which take place in winter) there is unfortunately less opportunity to nominate British

representatives ; but the Council was able to delegate Professor H. H. Turner to that duty at the New York meeting in 1928. In 1924 the American Association had generously undertaken to bring the Toronto meeting of the British Association specifically to the notice of its members. The result was that about 800 American scientific workers attended the meeting, which therefore proved to be the most comprehensive occasion which has arisen of recent years for co-operation between British and American science, for not only did the meeting itself give opportunity for this, but many of the British visitors enjoyed American hospitality either before or after it, together with some sight of American scientific advancement in universities and research stations.

Progress in Canada.

The Toronto meeting was otherwise notable because it was the first occasion of a second meeting in the same city of the Dominion (the previous meeting in Toronto was in 1897), and the remarkable developments in the university and the city during the intervening period could be appreciated by those visitors who were present on both occasions. Still more was this true in relation to the journey to the west which took place after the meeting. Those who had travelled across the western provinces after the Winnipeg meeting in 1909, and now did so again, could not fail to perceive the wonderful development which had taken place in fifteen years, not only in the special cultivation, but also in the general appreciation, of science. Universities either completely new or vastly enhanced in equipment, were seen in every western province. In 1909, when the train stopped for receptions in the western cities, formal communications between visitors and hosts took the form of speeches, at times with some reference to science, at other times with none. Of scientific lectures there were hardly any. In the course of the western journey in 1924, forty lectures were given by members, including several at special sectional meetings held in the University of Saskatchewan at Saskatoon and the University of Alberta at Edmonton. Such lectures were asked for by the institutions visited, where in 1909 (speaking generally) there was none to ask. And in return the visitors heard from workers on the spot accounts of their own scientific problems and of their work, where in 1909 there was none to tell of them. In those fifteen years the seed which had been sown had begun to yield harvest ; and there was gratifying evidence that some of it, however tentatively, had been sown during the Association's visits in 1909 and earlier. The route of the journey in 1924 was more comprehensive than any followed previously, as it led westward by the transcontinental line of the Canadian National Railways and returned by that of the Canadian Pacific system. Many visits or deviations were arranged to suit special interests, such as those of geologists, zoologists, and agriculturalists ; but all interests were constantly engaged.

In 1929 the Association paid its second visit to South Africa. The support accorded in South Africa itself by way of membership of the Association was very materially less than that given in 1905. This was a "rub of the green" such as the Association with its present organization, and probably almost any institution under present conditions, must on occasion endure, and it connoted no lack of interest in science in the Union. Public lectures were asked for with a gratifying freedom, and as far as circumstances allowed, they were given. Hospitality was unlimited, as it always is in the Dominions. And here let it be said that the Association, on the occasion of its Centenary Meeting next year, has an opportunity unique in our time, not indeed to repay in full its debt for hospitality overseas, but at least to demonstrate to visitors from overseas its appreciation of their Dominions' generosity in the past ; of this opportunity home members will not be slow to take heed.

Wider Activities.

The effects and results of overseas meetings of the Association are never confined to the meetings themselves, and this fact was exemplified afresh in 1929. The first visit of its type to a colony in the Association's history was that paid to Kenya by two parties on their way home from South Africa ; a week in each case was devoted to sight-seeing scientifically arranged and informed, and lectures were given by visitors. Other journeys by parties in the Union and Southern Rhodesia were of great scientific interest, and much important work was done outside the actual programme. Thus, some of the visiting astronomers were able to enquire into the extension of observatory work in South Africa ; the anthropologists and the archaeologists had opportunity to see something of native peoples and evidences of their earlier arts and activities ; the geologists co-operated with the International Geological Congress, not only in meetings but in field-work, and the agriculturalists with the Pan-African Agricultural Congress at Pretoria. The Association française pour l'Avancement des Sciences invited members not attending the South African meeting to join it at Havre, repeating the friendly gesture of 1914.

An investigation of certain of the famous Rhodesian

ruins, at and in the neighbourhood of Zimbabwe, was carried out under the direction of Miss Caton-Thompson, at the request of the Council of the Association and at the charge of the Association aided by a grant from the Rhodes Trustees. Miss Caton-Thompson's work carried on, amplified, and confirmed that of Dr. Randall-MacIver done on the occasion of the Association's previous visit, in 1905. During the present year a loan collection of objects from Zimbabwe and elsewhere was organized on behalf of the Association with the generous co-operation of museum and other authorities in Southern Rhodesia and the Union, and was exhibited at the British Museum. Miss Caton-Thompson's report of her work will be published in due course, with the aid of a grant from the Association.

Imperial Functions.

No apology is offered for referring to the Toronto and South African meetings more fully than the rest. An enthusiastic president said of the first of the Association's meetings overseas (1884) that it marked a distinct epoch in the history of civilization. Possibly the speaker's intention was clearer than his meaning; but these meetings overseas are outstanding events in the history of the Association and in the experience of those who take part in them. Other organizations help to strengthen the scientific bond throughout the Empire, but they represent each a single science or group of sciences. The British Association is alone, in this connexion, in covering the whole field of science; for that reason if for no other its imperial functions are among its most important.

A spirit of co-operation which was not known among scientific societies in former years has made itself manifest during the decade. Once distilled, it has proved very fairly strong, though unless conserved it may be subject to a tendency to evaporate. It was not strong enough to bring about a union between the Association and the British Science Guild, for which a scheme was worked out. Within the Association, however, it has shown itself since in 1921 the organizing committees of the Sections took to meeting jointly as well as severally to consider their programmes, an excellent provision, since it gave opportunity to make fuller use of one of the Association's exclusive attributes, that of providing a common meeting-ground for all kinds of scientific workers, and to arrange more of the joint meetings between two or more sections which make possible the discussion of what are called "border-line" subjects. The same spirit of co-operation has acted in another direction by causing the calling of meetings of representatives of all appropriate societies to deal with questions of common interest, such as that of establishing a central institution for the encouragement of anthropological studies, and again—a matter of still wider concern—the liability of scientific societies to income tax. In this last connexion the Association has found it possible to offer a measure of advice to other societies when appealing against the taxation of their incomes, and it was offered that the office should become a recording centre of the results of individual societies' appeals, in order that such records might be available for consultation and general guidance.

The institution of the joint meeting of organizing committees was one of the most valuable reforms introduced by the former General Treasurer, Dr. E. H. Griffiths; a second was the investment of life compositions (a practice which had escaped attention previously). A third was the establishment of the so-called exhibitions, which enable a student selected by each university and university college in the United Kingdom to attend an annual meeting without expense to himself or herself. Several of the institutions invited to nominate exhibitioners are able to assist others of their students to attend meetings, where they may hear and make personal contact with their seniors in their selected branches of science. The value of this new provision for science students is self-evident, both from their own standpoint and from that of the Association, for it is in the hands of these and their contemporaries that the future of the Association lies.

Safety in Mines.

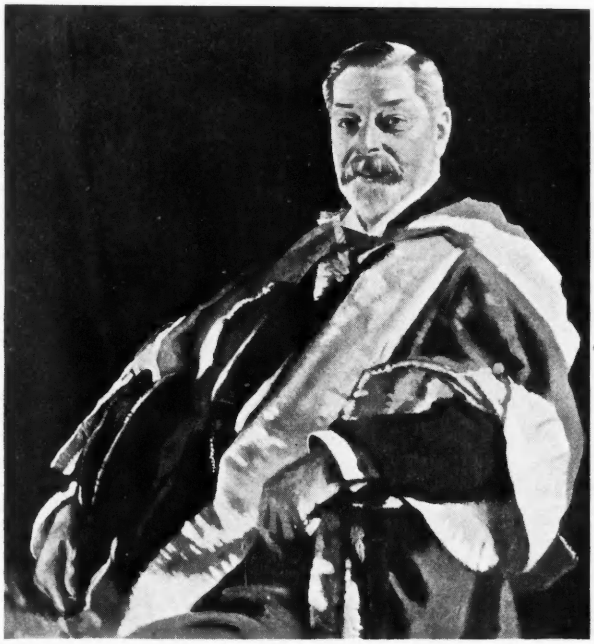
In *Discovery* for August, particulars appeared of a new safety lamp that combined the "flame" detection method with electric illumination. The U.S. Bureau of Mines has since issued details of another device for detecting carbon monoxide. This consists of an easily crushed cotton-covered ampoule filled with a solution which changes colour when exposed to air containing carbon monoxide. In appearance the ampoule is similar to those filled with aromatic spirits of ammonia for giving inhalation treatment, or those filled with iodine for first-aid treatment of wounds. In use the carbon monoxide ampoule is crushed, which wets the cotton covering with the solution. It is then exposed to the air to be tested. After a prescribed period of exposure the colour is compared with a chart and the amount of carbon monoxide estimated. The detector was devised primarily for examining the air of man-holes and sewers.

The New President : Professor F. O. Bower, F.R.S.

(By a Special Correspondent.)

THE President of the British Association for 1930 is Professor F. O. Bower, the distinguished botanist, who occupied the chair of Botany at the University of Glasgow from 1885 to 1925. Before his appointment to the Scottish chair, Dr. Bower was Lecturer in Botany at the Imperial College of Science, South Kensington. He was born at Ripon in 1855, and was educated at Repton and Trinity College, Cambridge.

Professor Bower has made research and the teaching of botany his life work, wisely choosing to devote his attention to one branch of scientific thought than to embrace a variety of subjects which have no bearing on the main interest of his life. Not every Englishman can claim to have been a success in a Scottish chair, but there is no doubt that the new President was eminently successful, both in the teaching of a subject usually considered rather uninteresting and in his sympathies with the students in their athletic and other recreational activities. As a lecturer Dr. Bower was fluent and incisive, and his manner of teaching made the learning of a difficult subject comparatively easy.



PROFESSOR F. O. BOWER.
From the portrait by Sir William Orpen.

Botany is a branch of science which does not make a particularly ready appeal to the popular imagination ; a botanist does not discover curious animals in untrodden jungles, nor does he discourse on themes of such magnitude as the speed of light or the temperature of the stars. Nothing theatrical is associated with a chair of Botany, and writings of a botanist are by no means sensational. But this year's President may be trusted to interest his great and representative audience as genuinely as any of his distinguished predecessors. Professor Bower will wear the blue ribbon of extra-academic science with as much distinction as any previous occupant of the Presidential Chair.

In the course of a long scientific career, the President has written several valuable wor s and monographs dealing with plant life. One of the earliest was a small but admirably arranged handbook to the botanical laboratory. No beginner in botany could have had a clearer guide to the microscopic structure of plant tissues. In the session of 1917-18 Dr. Bower and his colleague, Graham Kerr of zoological fame, delivered a course of lectures on "Sex and Heredity." These were afterwards published in 1919, and they form a valuable contribution to the physiology of reproduction in plants and animals. In the same year the President published in the "Pioneers of Progress" Series a short life of Joseph Dalton Hooker, the great English botanist so long at Kew. Dr. Bower has also written most acceptably for the non-scientific reader. He published in the *Glasgow Herald* a series of articles dealing with the relationships of plants to men, and collecting these in 1925, he published them as a separate volume, called "Plants and Men, or Essays on the Botany of Ordinary Life." The character of this interesting book will be understood from the following list of some of the subjects it deals with :—Meadow and pasture ; woodland ; moor and mountain ; golf-links and playing fields ; the sea shore ; the flower garden ; the kitchen garden ; dessert fruits ; cereal grains ; timber ; twine ; parasitism ; the fungal habit ; scavenging and

sanitation ; man's dependence on the vegetable world ; and, finally, man's influence on the vegetable world. The chapter on bacteria is particularly valuable, and the illustrations throughout the book are excellent.

Research on Ferns.

Much of the President's reputation as a botanist rests upon an elaborate and highly technical work dealing with the great group of the ferns (*Filicales*) which appeared at Cambridge in three volumes between 1923 and 1928. Dr. Bower has published many papers on the Ferns, both in the Philosophical Transactions of the Royal Society and in the "Annals of Botany." Another technical work, "The Botany of the Living Plant" (1919), is regarded by fellow botanists as an important contribution to their science. In the realm of scientific speculation, Professor Bower is known as the expounder of a hypothesis concerning the "Origin of a Land Flora" (1908). To this problem he has given much study, and it formed the subject of his "Hooker Memorial Lecture" in 1917 and of his "Huxley Memorial Lecture" in 1929.

To appreciate the theory fully one must, of course, have had some training in botany, but briefly the hypothesis is as follows: Originally plants were marine, and had what is called "alternation of generations," that is to say, between any two gametophytic phases a sporophytic phase intervened. The plants that live on the land are the land-living sporophytes, the gametophytic phase having become inconspicuous. Subsequently in certain algae, and particularly in the Archigoniatae, a sporophytic phase was interpolated in each life-cycle between the successive gametophytes. In land vegetation this latter phase has attained such preponderance that the original gametophyte has been overshadowed by it and virtually eliminated. The diploid plant-body, though secondary in its origin, now constitutes the vegetation of the land.

The President has been honoured by several universities and learned societies in this country and abroad. As far back as 1891 he was elected a Fellow of the Royal Society, on whose council he served in 1901 and 1902 and again from 1925 to 1927. In 1909, he was awarded the Royal Medal of the Royal Society in recognition of his valuable contributions to botany, both systematic and theoretical. In the same year he was honoured with the gold medal of the Linnaean Society, undoubtedly on account of his work, "The Origin of a Land Flora." Professor Bower has been President of the Royal Society of Edinburgh, and was the recipient of its Neill prize in 1926. His Cambridge Alma Mater conferred on him the degree of Scientiae Doctor (Sc.D.), a very carefully guarded honour, while from the Universities of Dublin and Sydney he has received the degree of D.Sc. He is also an LL.D. of Glasgow and Aberdeen Universities.

The President is a corresponding member of the Botanical Society of America, of the Royal Botanical Society of Belgium, of the Academy of Science of Munich and of the Royal Danish Society, an Honorary Member of the German Botanical Society, and a corresponding member of the Royal Academy of Turin. He has been three times President of the Section of Botany of the British Association, and has taken as the subject of his Presidential address to the whole Society the problem of "Size and Form in Plants." This topic, one of considerable interest to all biologists, forms the theme of a volume shortly to be published by the Macmillan Company. The President's zeal for Glasgow University did not cease with his resignation from office, for he continues even now to serve the interests of the Scottish university in more ways than one. Not long ago, Dr. Bower presided at an interesting gathering of the Glasgow University Club in London. His portrait was painted by Sir William Orpen in 1927, and appropriately hangs in Glasgow University.

Grand Canyon Expedition.

In the scientific study of the Grand Canyon, some of the most recent advances have concerned the extraordinary story of life of the past preserved in the geological strata. Fossil plants and the traces of many extinct animals have been found in abundance in formations dating back approximately to the age of coal plants, or what is known as Permian time. There also were seen early examples of the great race of reptiles shown in many types of life as yet imperfectly known. Another discovery of much importance is represented by lowly types of plants discovered as fossils in rocks, the so-called Algonkian rocks, that represent one of the earliest periods from which remains of life have been obtained.

An American expedition has just returned from the Nankoweap Valley, an isolated and little known basin in the extreme north-eastern part of the Grand Canyon. The exposed rocks in this area are chiefly Algonkian. Because of their great age they are of special interest to those who are searching for evidence of ancient life. Dr. C. E. Resser, Curator of the United States National Museum, the leader of the expedition, reports that abundant evidence of aquatic plant life was discovered but no traces of animal life.

The Discovery of a Pyramid.

By Eduardo Noguera.

Translated from the Spanish by Professor A. S. Riggs.

The discovery in Northern Mexico of the Pyramid of Tenayuca has thrown valuable light on the architecture of the Aztecs, a race which inhabited the country during the middle ages. Excavations have been conducted on an extensive scale during the past five years, and the district has proved an important field for archaeological research. Many ceramic fragments of artistic value were discovered.

THE most important archaeological discoveries made during recent years in Mexico have without doubt been those dealing with the Pyramid of Tenayuca, situated a short distance to the north of the City of Mexico.

These discoveries have clearly demonstrated and confirmed the chief characteristics of the architecture peculiar to the Aztecs, who so valiantly succumbed to the invasion of the European in the sixteenth century. Hitherto little has been known of the architecture of this important people. The ancient Tenoxtitlán, the fortified capital of the Aztecs, was obliterated by the Spaniards in their reduction of the country and subsequent establishment of their dominion. Only a few isolated edifices escaped this wholesale destruction, thanks in part to the fact that they had been erected outside the confines of the city, in part because they had been built by the Nahua tribes who previously occupied the Valley of Mexico.

For five years, beginning in 1925, the work of exploring these monuments has gone steadily on. Only now is the combined work of repair and conservation at an end. Hand in hand with it has gone the study of the history of the pyramid, made possible by means of the inscriptions and sculptures upon it, the small fragments of ceramics and other minor objects, and by the written records left by the first Spanish missionaries, who obtained their information direct from the Indians themselves early in the days of the Conquest. The work of exploration and conservation was undertaken by the Archaeological Department of the Mexican Government.

Before the work of excavation commenced the pyramid appeared much like a natural hill or mound, covered with scrubby vegetation, but its removal disclosed an exceedingly interesting monument concealing the debris of ages. The principal monument consists of a pyramid measuring

A DRINKING BOWL CARRYING SYMBOLIC DECORATIONS.
This style of motifs was found in many other representations, and is thought to be related with the religious beliefs of the people

BEFORE EXCAVATION.
The pyramid resembled a natural mound and was covered with scrubby vegetation. Its removal disclosed a monument rich with the debris of ages.

more than forty metres on each side and rising to a height of rather more than fifteen at the present time. Originally the height must have been considerably greater, since a large part has been destroyed by the natives of the region, who pulled out the splendidly hewn stones to use in their own structures.

The stairway ascends the western face of the pyramid. It consists of a double set of treads and risers, separated by a dividing mass of low masonry called an *alfarda*, which is a characteristic element of Aztec architecture. It is interesting to observe that many of the steps have carvings representing different symbols.

All this first construction conceals another edifice of greater antiquity, of which there remains in almost perfect condition an interior stone stair. Here, too, the steps are carved, as on the exterior; but in this case there appears a certain symmetry, which makes it clear that we are dealing with either a super-posi ion or that there may have been two different periods of construction. To both north and south of the pyramid, and at a distance of some eight metres from it, appear small platforms which may well represent altars, since before each we find beautiful, coiled serpents which indicate points in space. The serpent on the north thus points to the north-west, while its companion on the south side indicates the south-west. It has been thought that this arrangement and orientation was meant to convey the maximum separation of the points reached by the sun during winter and summer seasons.

Another important detail was the finding of a small platform at the foot of the masonry division of the exterior stairway. Within this we found a fresco representing crossed bones and human skulls richly ornamented. These motives are repeated on the exterior walls or sides of the platform, but they are carved in stone instead of being in fresco. Before concluding the excavation of the monument, it was considered essential to drive a tunnel through it, beginning on the east, to determine the number of interior structures there may have been and to ascertain the super-positions or amplifications of the edifice, besides definitely attributing each to its proper local culture. Two ancient edifices, much older than the pyramid itself, were encountered within it, representing four distinct epochs of construction or super-position.

Thanks to the discovery of this pyramid, it has been possible to classify the chief architectural characteristics of Aztec edifices. Done José Reygadas Vértiz, who conducted the excavations at Tenayuca, considers them briefly as follows :—

(i) Taluses, or slopes of abrupt inclination.
(ii) Decorative bosses or knobs upon the taluses.
(iii) Narrow spaces upon the taluses, not meant to be used as passage-ways or walks.
(iv) Stone stairways divided by double *alfardas* or low masonry partitions.
(v) The central *alfardas* present two changes of pitch of a determined height in such a manner as to form a small landing-stage.
(vi) Characteristic also of certain other cultures: super-position of two or more structures.

This discovery is important not only because of its

A YEAR LATER.
Numerous vases of great value were encountered and are here seen at the foot of the pyramid among piles of stone and human remains.

THE FOOT OF THE PYRAMID.
One of the small platforms with skulls and bones sculptured on the exterior. The trap door was built to protect the frescoes of the interior.

architectural significance, but also because the large number of small objects, especially ceramics, which invariably accompany this class of archaeological edifice, have served as a base for extended study. All the ceramic fragments were brought together and studied minutely. The resulting conclusions serve to corroborate much that history, as set down by the early missionaries, has told us about Tenayuca. I will not here enter into further details, since a complete account of these ruins is being prepared.

It is, however, possible to include in this short review those objects of most artistic value which were discovered at the foot of the platform which gives access to the exterior stairway. These were found mixed with human bones inside small cavities like sepulchres. One of the most interesting examples found represented a coyote, or perhaps a dog, in a seated position. By its zoomorphic form and because in one sense it constitutes a novelty among Aztec ceramics, it recalls similar specimens of Tarascan origin. The latter people manifested a distinct predilection for this class of figure. The hindpaws were very well executed, in contrast to the forepaws, which were scarcely more than indicated by light moulding. The head was an interesting piece of realism. The snout was extended, as is proper with this class of carnivores, the mouth being left sufficiently open to show the teeth. The tongue lolled out between the two canines, which curved downwards to meet the lower mandible. Instead of true ears, the figures carried two "earmuffs" or adornments, the left one being of the type known as *oyohualli*. From the posterior part of the top of the head opened the receiving aperture for the human ashes, the edges being extended and prolonged toward the rear. An oblique configuration of the eyes was another realistic detail.

Another funerial vase is a beautiful example of a perfumer or incense-burner, made of the finest clay, perfectly worked on the outside of a cherry-coloured base or slip. The triple supports of its base are decorated in deep incised reliefs which show eagles' heads and which also serve as rattles. The globular body of the censer carries decoration which is best described as lace or open work. It extends through the entire thickness of the wall in the form of circles. Alternate circles are perforated while the intermediate ones are in relief only, this being necessary for the solidity of the vase. The neck is almost horizontal, forming an acute angle with the body and the lip flares widely. The interior is neither well finished nor painted, and contained no calcined remains. A small drinking bowl was found, and is of interest chiefly because of its elaborate symbolic decoration. This style of motifs is to be found in other representations, which indubitably signifies some relation with the cult of the region and the religious beliefs of the people who constructed this monument.

AN INCENSE BURNER.
Made of the finest clay, this perfumer is a perfect piece of craftsmanship. The triple supports of the base are decorated in deep incised reliefs.

British Universities To-day : (7) Bristol.

By Thomas Loveday, M.A., LL.D.

Vice-Chancellor of the University of Bristol.

Resuming the review of British universities which was begun in DISCOVERY *last spring, our contributor shows how Bristol is notable for its rapid growth and the close connexions it has established with education generally in the west of England. The University enjoys the advantage of generous endowments.*

THE University of Bristol is twenty-one years old this year, but its roots go a little deeper into the past. The Bristol Medical School, itself the heir of a long tradition of medical teaching in the city, was established nearly a century ago; the Merchant Venturers Technical College, in which the faculty of engineering has its quarters, grew out of a trade school founded in 1856; and twenty years later came into being the University College which was destined to integrate these professional studies with those of pure science and the humanities in a larger whole. Some such unification as eventually took place was present to the minds of the promoters of the College from the outset; it was foreshadowed in a speech of Jowett which is still remembered; it was the clear idea of Percival, preaching that Bristol through its College, and eventually through its University, should be—as now is symbolized in stone by the great tower—"the lantern of the west." If, as has sometimes been said, the attitude of the public schools to the modern universities has been (at any rate until recent times) somewhat distant, let it be recorded on the other side that, if in any one man, it is in the inspired and inspiring vision of the great Headmaster of Clifton that the movement towards university education in Bristol had its origin.

Humble Beginnings.

The College began, of course, small, and was for many years poor in purse; but like the other provincial colleges of that time it was blessed in the services of very distinguished teachers, its three successive principals being Alfred Marshall, William Ramsay and Lloyd Morgan; it met a public need which its own exertions fostered; it was liberally aided and encouraged by Balliol and New College; and the increasing support of Bristol citizens, and especially of the family of Fry, gradually enlivened the demand for an autonomous university. In 1908 the gift of £100,000 by H. O. Wills (the founder of the University) made realization of the demand immediately possible; and on the joint application of the University College (with which the Medical School had been united in 1893) and the Society of Merchant Venturers, the charter was granted in the following year.

It is well known that the rapid growth of the University in the short period of its existence has been in great part due to the munificence of the founder's sons, who in addition to sums for endowment presented severally or jointly the new Memorial Buildings, the great physics laboratory, the Union buildings, both the halls for men, the playing fields, and other benefactions, amounting in all to over £1,000,000 in value. The larger buildings have been frequently described and depicted. Those who visit them should give a thought not only to the generosity of the donors and the architect's genius, but also to the devotion of the craftsmen who through years laboured to make every detail perfect in its kind. One of these craftsmen, carving oak, was asked by an onlooker how long he expected his work to last. "I don't know how long it's going to last, Sir," he replied at once, "but I'm making it to last for ever." Material beauty, so carefully designed and carefully wrought, is a precious influence in education, imperceptibly drawing the soul, as Plato taught, into conformity with the beauty of reason; and though the principle is trite, the rapidity of its exemplification was astonishing when undergraduates migrated from shabby huts into the new buildings. It should be added that these great gifts were so given and have been so administered that the maintenance of the fabric is no charge on the ordinary funds of the University.

The constitution of the University is similar to that of other modern universities and calls for no special comment, unless it be to note that non-professorial teachers are included not only on Boards of Faculty but also on the Senate by co-option and on the Council by election. Like all its fellows, the University of Bristol owes an incalculable debt to lay members of

Council, without whose unremitting care for its interests it could not have thriven nor now thrive. The cities of Bristol, Bath and Gloucester, and the counties of Gloucestershire, Somerset and Wilts, all aid the University financially and are represented on the Council ; they constitute its special " province " except for agricultural advisory work, which extends also over Worcestershire and Monmouth.

Four Faculties.

There have been from the beginning four faculties, that of arts being now slightly the most numerous and engineering the smallest, whilst the number of students reading pure science is approximately the same as the number of those aiming at qualifications in medicine and dentistry. It is hoped that before long the present department of law may flourish into a faculty, and that a faculty of theology may also be established. To students reckoned in the several faculties must be added those training for a qualification as teachers. Of these in recent years the majority have been graduates reading for a Diploma in Education, but there have also been some women pursuing a two-year course of study for a certificate ; no fresh entries for two-year courses are now accepted. The total number of students is about 950 ; the number tends to rise in a steady and manageable way.

The great bulk of the work within the faculties, in respect both of teaching and of research, however much it may in detail and in particular emphasis differ as between one university and another, is in general character alike everywhere, and so requires no detailed description. Special features at Bristol are largely the result of the policy which the University has adopted from the first of associating with itself institutions doing congruous work. With the faculty of arts there are connected two theological colleges in Bristol, one in Salisbury and one in Warminster, at which candidates for the B.A. degree who specialize in theological subjects can pursue part of their curriculum. Men reading for the B.Sc. degree in agriculture spend their first year and certain other periods later at Bristol, the rest of their time at the Royal Agricultural College, Cirencester, and on a selected farm. Women reading for the B.Sc. degree in domestic subjects spend three years on pure science at Bristol and one on its practical application at the Gloucestershire Training College of Domestic Science. In the faculty of medicine there has, of course, always been a very close connexion between the University and the hospitals of the city in which clinical studies are pursued, the two main hospitals being the Bristol Royal Infirmary and the Bristol General Hospital. Lastly, the faculty of engineering, which, as has been mentioned, is housed in the Merchant Venturers Technical College, was for many years entirely and is still in great part equipped and maintained by the ancient Society of Merchant Venturers, which in many ways has been a pioneer in educational work in Bristol.

The new main buildings of the University, which were opened by His Majesty the King in 1925, accommodate the administration and the faculty of arts, and the general and medical libraries. The scientific and medical departments, except physics and mathematics, are house in older buildings close by, the most recent being the chemical wing, opened in 1910. The chemical laboratories were very carefully designed and still serve their purpose excellently, but they are excelled in spaciousness by the new physics laboratory which crowns the Royal Fort Hill about a quarter of a mile away. This great institute was opened in 1927, and finds room for the department of mathematics as well as for experimental and theoretical physics, and the facilities in it for research have already attracted advanced students from the Continent, America and Australia, as well as from other parts of this country. Whilst several lines of research are at present pursued in it, investigation shows a tendency to concentrate round problems of molecular structure.

The Colston Society.

An institution of great value to the University is the Colston Research Society, the youngest of a number of societies which commemorate the philanthropic and educational zeal of Edward Colston. Founded in 1900 to aid the University College, it has since the inception of the University had for its aim the promotion of research within the University. It is an association of Bristol citizens which, like the other Colston societies, holds an annual dinner and makes an annual collection, the proceeds going entirely to aid research. Since 1900 the collections have amounted to over £15,000. Under the auspices of the Society also Bristol firms have from time to time provided research fellowships which have been held by graduates of the University. During the last two years the scope of the Society's activities has been enlarged by the receipt of capital sums to be held in trust, the income being devoted to aiding research, and it has been decided to use the income from one such gift in the first place to aid investigations into means of combating certain insect pests of fruit.

This application of the fund is an instance of the close ties between the University and the principal

industries of the area which it specially serves, agriculture and horticulture. Bristol itself is, of course, a large industrial as well as commercial centre, but (fortunately in these times) it is much less specialized industrially than most large towns. There is also a considerable variety of industrial works in the smaller towns of the area. But, taken as a whole, the district is predominantly agricultural, and in one way after another the University has succeeded in extending its work on behalf of agriculture. The association of the College at Cirencester, already mentioned, dates back to the foundation of the University, though the provision of degree courses is more recent. To the same date belongs the association of the National Fruit and Cider Institute, which soon developed into the Long Ashton Research Station.

Fruit Research.

The station does advisory work throughout the province, and is also the primary national centre for research into fruit culture and the practical treatment of plant diseases. Recently the work done there on spray fluids designed to destroy pests of fruit trees in the egg stage, has resulted in the production of a very effective egg-killing wash which is now manufactured on a large scale by spray fluid makers. Valuable results have also been reached in the last few years concerning the nutrition of fruit trees, and many other promising lines of work are constantly opening up. The original interest in cider-making still continues, and the marked improvement during recent years in the general quality of this increasingly popular beverage is largely due to the Station. Problems relating to willow-growing, an industry of some importance in Somerset, have also been under investigation for several years past.

Another institution for which the University is responsible is the Research Station for Fruit and Vegetable Preservation at Chipping Campden. This station came under its management after the end of the war, and has been of great assistance to the rapidly growing canning industry in the country. It is also responsible for holding courses in domestic preservation of fruit, and on this side has worked in close association with the Federation of Women's Institutes.

Provision having thus been made for fruit and horticulture, the University a few years ago decided to increase its work on behalf of general agriculture by appointing an agricultural information officer, who should keep practical farmers in touch with the results of scientific research directly valuable to them. This appointment, which was novel and made independently of the Ministry of Agriculture, aroused the Ministry's interest and led to the establishment of an agricultural advisory centre which is housed close to the University. The centre works in close touch with the county agricultural organizers and has grown very rapidly; calls for its assistance have grown with at least equal rapidity.

The absence from Bristol of industrialized environs brings other advantages, particularly in the ease with which students in such subjects as botany and geology may be brought quickly into touch with field work. The sea-board of the Bristol Channel, the moors of Mendip, and even the mud of the River Avon are a constant source of study by the botanists, whilst a valuable adjunct to this department is a small but well equipped garden at the very doors of the laboratory. Students of geology are fortunate in working in a district rich in geological interest, as indeed its scenic features would lead one to expect. It is no small advantage to have within walking distance the Avon Gorge, a unique section through carboniferous limestone and in itself an introduction to the subject of geology available to any freshman.

A considerable proportion of the students of the University are candidates for the teaching profession, and most of these are aided by grants from the Board of Education. (The Board's system of awarding grants has been much criticized of late, and Bristol has acted with certain other universities in suggesting a more flexible scheme.) The home of the department of education is the Royal Fort House, a beautiful eighteenth century building on the site of a fort, which was held and lost first by Colonel Fiennes for the Parliament and then by Prince Rupert for the King; the house is noted for its ceilings and friezes, and for its garden designed by Repton. It is chiefly in their graduate or professional diploma year that students work there, though during their academic studies they are in various ways brought into touch with the department, not least by having to join the choir.

Training Colleges.

Though it no longer accepts intending teachers for a two-year course, the University is kept in touch with the briefer system of training through the part it plays in the examination of training colleges. When the Board of Education recently decided to abandon its own examination for its certificate and asked the universities to organize local schemes, Bristol was one of the first to respond. An examining board was formed, styled the Western Joint Committee of the University and Training Colleges; six colleges came

[*Aerofilms*]

BRISTOL UNIVERSITY FROM THE AIR.

into the scheme, and the second annual examination has just been completed. With the secondary schools of its area, again, the University keeps in close touch, partly by conducting examinations for the school certificate and higher certificate and partly by a conference which is held annually and attended by headmasters and headmistresses of secondary schools and representatives of local authorities as well as of the University.

All universities nowadays recognize a duty to those who, prevented from attending their ordinary courses, are yet desirous of and capable of profiting by teaching and discussions of university quality. This work of adult education, carried on partly by extension lectures and partly by tutorial classes, has grown rapidly in the Bristol province, and is now organized by a director of extra-mural studies. There are special difficulties in extending it through a large area not very thickly populated and not very well served by rapid transport. These difficulties have been met by the appointment of resident tutors, at present two in Somerset and one in Gloucestershire, who give their whole time to the work and, living in convenient central places, can reach even the most outlying villages. The tutors work in close co-operation with the rural community councils, and their efforts have resulted in a notable stimulation of intellectual interests in the rural districts. Extension lectures of the older type are organized under a joint board of the University and the University Colleges of Exeter and Southampton.

Collegiate Life.

Nothing in the current history of the modern universities of England is more remarkable than their gradual conversion to belief in the value of what may be called roughly collegiate life for undergraduates. Reading, which was never predominantly a local institution, maintained this faith from the outset, and so, of course, did the comparatively ancient University of Durham ; but the others, originating in colleges designed to serve primarily a particular city, have been slow in facing the problem presented by students who come from a distance, and were long content, at any rate as regards the men, to allow them to live in lodgings, a practice which often leads to under-feeding and which is apt to produce the virtue of self-reliance distempered by a marked angularity. Women students, it was allowed, deserved or required more consideration ; but it was rather to secure their parents' approval than because common residence was thought good for themselves that hostels were provided even for them ; and for men little was done for a long time, except here and there by some religious denomination.

Bristol has been in this matter a little in advance of most of its fellows, and naturally so, since the problem has here presented itself more urgently owing to the size of the University's province, and the scattered distribution of the population. The proportion of students living at home is markedly below the average. About the time of the foundation of the University there was presented as a hall for women a famous old house in Clifton, once the home of Dr. Addington Symonds, and like the Royal Fort House noted both for its eighteenth century decorations and for its gardens. To this was added subsequently a neighbouring house, so that this hall, together with some smaller hostels shortly to be merged in a second large hall now in process of construction, accommodates all the undergraduate women who are not living with parents or near relations. For many years the men fared less well. There was indeed a single hall for men, but it was not well situated, nor could it meet the demand for rooms. More recently, however, gifts to which reference has already been made, have radically altered this unsatisfactory state of affairs, and the University now possesses two excellent halls, one an old Clifton house, holding about thirty-five men, the other (known as Wills Hall) a beautiful quadrangular building situated in an estate of over 20 acres, and containing 150 residents. To the Wills Hall there has quite recently been made the additional gift of a chapel. All undergraduate men, not living at home, have now to spend so much of their time as may be ordered in a hall. As numbers grow, residential accommodation will have to be still further increased, for it can safely be prophesied that except for medical students in their years of clinical study and other special cases, the rule requiring residence in a hall will be firmly maintained.

The Union.

It is interesting to notice that the men living at home or in registered lodgings have recently determined to achieve for themselves such benefits of community life as may be practicable by organizing themselves into a society which they have called the Haldane Society, in memory of the late Chancellor to whose guidance the University owes so much. The headquarters of this Society, as of all other undergraduate societies, is in the Union, which has for its habitation the Victoria Rooms, long the Assembly Rooms of Clifton. This handsome building contains, in addition to a refectory and common-rooms, a large hall with a stage and an organ.

(Concluded on page 317.)

Atlantic Transport by Air.

By J. L. Nayler, M.A., F.R.Ae.S.

Secretary of the Aeronautical Research Committee.

The record flight of the R. 100 raises the question how soon air transport to America will become a commercial proposition. Less than one hundred years ago, addressing the British Association at Bristol, a speaker said that a steamship would never be able to carry enough coal to allow it to cross the Atlantic !

THE Atlantic has been crossed many times by air and up to the end of July, 1930, more than 200 persons have made this flight. It is but reasonable to assume that just as the first ocean crossings were in small parties so also will it be the case with air crossings ; to obtain a proportional improvement the reader will not, howe er, expect a similar lapse of more than two centuries between the voyage of the *Mayflower* and that of the first steamship. Before we delve too deeply into the future we will look briefly at the feats already accomplished. It will be convenient to consider alternately the use of airships (buoyant craft) on the one hand and of heavier-than-air (dynamic) craft on the other.

Three Factors.

H.M. Airship R. 34 with 34 persons on board crossed and recrossed the Atlantic in 1919 without much preparation. She left East Fortune before dawn on 2nd July, and after encountering much bad weather on the latter part of the flight reached New York after a journey lasting just over 108 hours, where, by first landing by parachute one of her crew who directed operations, an arrangement of wires from the ground to the ship was prepared so that the ship could be moored in what might be termed mid-air (see Fig. 2). This method of mooring is always possible in an emergency. The airship took on board new stocks of fuel, ballast and food and returned to Pulham, Norfolk, in the flying time of three minutes over 75 hours. This brief recital of facts brings out immediately three things :—(1) the much shorter time taken on the return route, which implies a good knowledge of the weather ; (2) the need of careful navigation ; and (3) the necessity for a ground organization to deal with large airships if they are to be used extensively for passengers and for transportation of goods. As regards (1), aircraft are in many senses more dependent on the weather than modern liners, but less so than the old sailing vessels.

Since the year 1919 the Atlantic has been crossed several times by airship, and the Graf Zeppelin has made the journey on several occasions. It is significant that her East to West crossings have been via the Azores and over the southern part of the North Atlantic while the return journeys were roughly along the shipping route. Amongst these must be reckoned that during her historic flight round the world when she flew a total of 21,500 miles in a time (including stops) of 21 days $7\frac{1}{2}$ hours, and made one crossing, that of the Pacific Ocean from Tokio to Los Angeles, of 5,400 miles, which is much greater than the distance normally flown in an Atlantic crossing.

Let us now recall crossings made in seaplanes and aeroplanes. The American Navy used three flying boats, N.C. 1, N.C. 3 and N.C. 4, to fly from Trepassey Bay, Newfoundland, to the Azores on 16th May, 1919. This flight was one of a series of hops with stoppages for refuelling and repairs. The first direct flight between America and Europe was that of the late Sir John Alcock and Sir A. Whitten Brown who flew in a Vickers' Vimy twin-engine biplane from Newfoundland to North-west Ireland in 16 hours 12 minutes, on the 14th June, 1919, the same year in which H.M. Airship R. 34 made the double crossing a few weeks later.

Spare Engines.

Many similar single crossings have been made, including the famous (and first solo) flight of Charles Lindbergh in a Ryan monoplane on 20th May, 1927, from New York to Paris without a stop. It must for our present purpose be, however, remembered that he was the seventieth person to fly the Atlantic Ocean. Many unsuccessful flights followed which were accompanied by loss of life, and so took from other successful flights some of their glamour. All such crossings by dynamic aircraft are dependent upon the engine running without stopping for a large number of hours and, on this account, the latest flights have been made in three-engined aeroplanes, which are capable of flying with two engines only.

All the above had a prevalent wind in their favour and an extensive coastline normal to their direction of flight. The reverse is the case for an East to West

crossing, for the prevailing wind is then a head wind and the coast to the south falls rapidly away and to the north (Labrador) is inhospitable. For these two reasons, a smaller number of attempts have been made to cross the Atlantic in this direction and very few have been attended with success. The Americans in their "Round the World Flight" in Douglas aeroplanes favoured the northern route via Iceland and Greenland. Baron von Huenefeld and Captains Koehl and Fitzmaurice in a three-engined Junkers monoplane made the direct flight from Baldonnel, Ireland, to Greenly Island, Labrador, on the 12th April, 1928, covering 2,070 miles in 37 hours. Quite recently a second direct flight was made by Captain Kingsford Smith in a three-engined Fokker aeroplane, the "Southern Cross," from Dublin to Harbour Grace, Newfoundland, taking a little less than 32 hours. Both the latter grumbled at their compasses and neither had much spare fuel for continuing the flight. The former were fortunate in landing at a place not too distant from civilization and the latter in having wireless by whose aid the aerodrome at Harbour Grace was located after two or three hours flying around in a fog.

This brief recital of facts clearly brings out the necessity for increasing scientific knowledge to solve certain problems. As before, there is an acute need for better knowledge of the weather conditions and for satisfactory navigation. In addition we observe that on the West to East flights there is some margin in the fuel load that can be carried by present-day aeroplanes, which load might be replaced by passengers or goods; but in the reverse direction the safety line is nearly approached.

Two ways of getting over the last difficulty have been put forward and both have as their basis a reduction of the length of the hop, or the distance between landings. Both would need more ground organization than is at present in existence. The British Government are prospecting the northern route via Iceland which involves no sea flight longer than 300 miles and introduces certain subsidiary problems which we will mention. The other solution is that of floating islands in mid-Atlantic (see Fig. 4), where seaplanes and aeroplanes can land to refuel and, if necessary, to refit. The depth of the Atlantic is such that fixed islands are not a feasible proposition, and whether the sum of two or three million pounds estimated as required for a floating island can be found to carry out what will be a gigantic experiment remains to be seen when the cross Atlantic air traffic is of sufficient volume to warrant its trial. There remains the southern route via Spain and the Azores, which is very much longer than the Iceland route as the latter lies near a great Circle between Great Britain and central Canada (see Fig. 1).

As already mentioned, a knowledge of the weather conditions is essential for both types of aircraft. In the case of airships, it is possible to steer so as to get assistance from the wind. For flights from Europe it is necessary to go south to the Azores to find a prevailing wind from East to West. By the direct route advantage can be taken of the cyclone's rotation. A depression formed in the Atlantic proceeds roughly along the course of the Gulf Stream and has a velocity as a whole in that direction, while at the same time rotating in a counter-clockwise sense. Consequently airships fly on the northern edge of a depression when going West and on the southern edge when travelling East. It is, however, essential to know where the cyclones are and in what direction they are travelling. During an early flight of the Graf Zeppelin between the Azores and Bermuda the Captain received by wireless a weather map which was, however, faulty in certain respects and resulted in his meeting unexpectedly a severe down current that damaged one of the horizontal tail surfaces. With the spread of meteorological knowledge and the aid of reports that are available from the shipping on the Atlantic routes a better weather map can be made of the direct route, and it is maps of this part of the ocean which were successfully transmitted by wireless to R. 100 during her recent voyage. It is difficult to see how at present aeroplanes can carry the necessary weight of apparatus for similar reception, and they would therefore need to rely on ordinary wireless reception of reports sent to them. Given better knowledge an aeroplane might with advantage alter its height of flight to get more favourable winds,

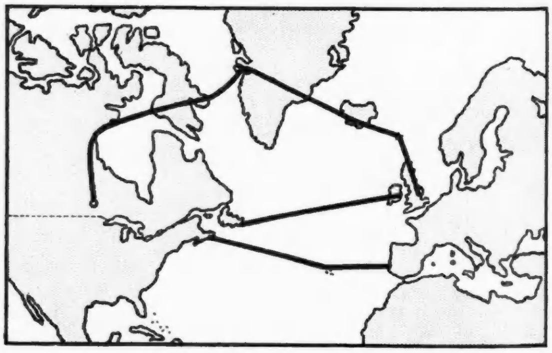


FIG. 1.
MAP OF THE ATLANTIC ROUTES.
Uppermost is the proposed Arctic route to Canada; the middle and lower lines represent the direct route from Ireland to Newfoundland, and the southern (Spain-Azores) route.

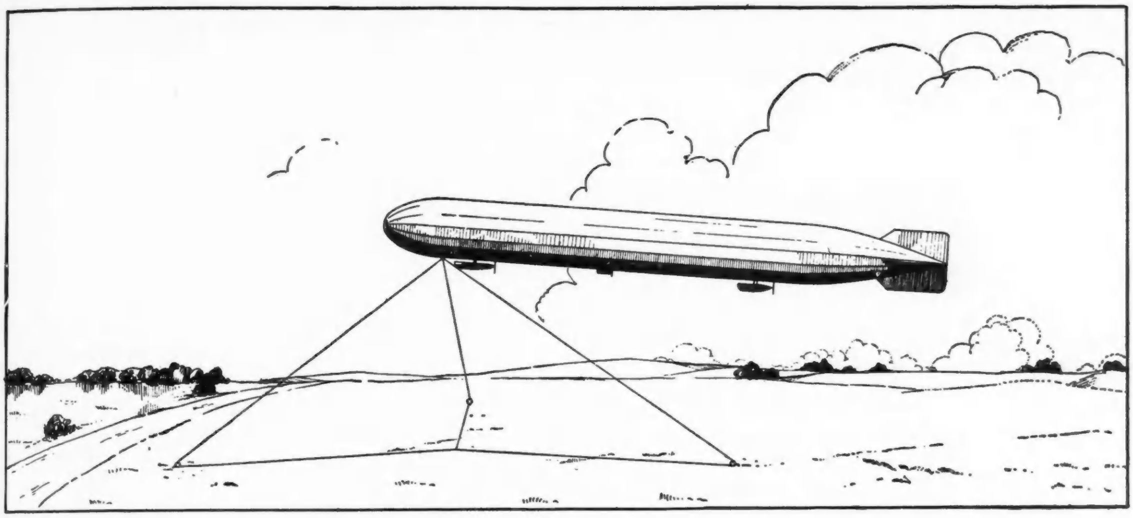


FIG. 2.
TEMPORARY ARRANGEMENT OF GROUND WIRES FOR MOORING AN AIRSHIP.

and in this respect has some advantage over the airship where large changes of level are avoided to minimize the consequent use of ballast or the necessity for valving gas, to adjust the total buoyancy of the airship to the changed conditions.

In the direct East to West route a real difficulty of the Atlantic crossing is the fog bank so frequently present near the Newfoundland coast, a loss of visibility resulting which may not be of such importance to the airship with its greater range and its ability to hover over a given spot without expenditure of fuel; the dynamic craft has, however, to find a landing place within a very limited time, and for this reason the northern route via Iceland is favoured by some authorities since the Great Circle (shortest) route from the North of Scotland to Winnipeg avoids the whole of this fog area.

The northernmost route brings other difficulties to the fore as the Ice Cap of Greenland is some 7,000-9,000 feet above sea level, necessitating a climb to that height and flight over most inhospitable country, though so far as data are available the general weather conditions appear to be satisfactory.

Associated with all flights over long distances and whatever the weather conditions is the problem of accurate navigation. An aircraft flies in the air, perhaps at first sight an unnecessary remark to make, but because of this fact its path relative to the earth's surface is compounded of its speed through the air and the speed and direction of the wind over sea or ground. Wind speeds are a large percentage of the speed of aircraft, and a much greater percentage than that of the tides on the sea are of the speed of marine craft. It is, therefore, most important for an air navigator to know the amount of his drift, and this he can estimate by various means. He knows his air speed from an instrument carried on the aircraft, so that if he knows his angle of drift he can calculate the course he has to set by compass. Over land, observation is made of some prominent object on the ground, whose direction of movement relative to a fixed line parallel to the centre line of the aircraft can be found by setting a bar so that the object moves along it. Various types of drift indicators have been designed which all embody this principle, and by two such measurements with the aircraft flying on two compass settings at a large angle to each other (45° to 90°) an absolute calculation of speed is possible. A moving line of beads in an instrument has likewise been used to measure directly the ground speed against some prominent fixed object. When over water, a flare is dropped and used in the same way as the fixed object.

Lindbergh, during his flight, took observations from time to time of the direction of the sea waves, which were a measure of the wind direction at sea level, and he was fortunate in having almost constant wind conditions throughout his flight. Whitten Brown was not so fortunate as the weather was changeable during the crossing. He carried a sextant and was able in mid-Atlantic to get a few readings from observation of the sun, the mean of which readings had little error, so that he corrected the compass course and Alcock and he made land on the north-west coast

of Ireland. The sextant cannot, however, be regarded as a suitable instrument for use on aeroplanes owing to the unsteadiness of the platform from which the readings have to be taken and the uncertainty of the horizon—artificial or real—which is used by the operator.

With the advent of directional wireless there seems to be little doubt that future aerial navigation over long distances will be by its aid. Even during the war the Zeppelins sent out signals which were picked up by German stations, who then 'phoned to the airships their positions. Similar means were adopted by Kingsford Smith to locate his aerodrome in Newfoundland during this summer's East to West flight, but the method is unsatisfactory. There seems to be no reason why airships at any rate should not carry directional wireless, as British ships must carry instruments of this kind sufficiently reliable to determine the direction of thunderstorms with the intention of avoiding such disturbed atmospheric areas. The transatlantic dynamic aircraft will, on the other hand, probably depend on a means similar to that under extensive trial on the air mail routes in the United States of America.

As at present arranged there seems to be no reason why the American scheme should not be extended for use over much greater distances and so adapted for crossing the Atlantic. A scheme was already working between Boston, Chicago and Omaha in the spring of 1929. Wireless signals from directional beams are heard in the pilot's cockpit so that he can tell when he deviates from the line joining two stations. By the visual method a system of coloured lights shows whether the aircraft is to the right or left of the course. In the aural method, which seems to be preferred, wireless signals of "Dash-Dot" representing the letter "N" and "Dot-Dash" representing the letter "A" are sent out in alternate quadrants (see Fig. 3) for stations 100 miles apart. On the line for the station the pilot has a mixture of the signals which sounds to him as a series of dashes, and if he wanders from the direct path he will hear either "N" or "A." The scheme outlined for the country is arranged on the 285-350 kilocycle band of waves. Complementary with the scheme is a weather transmission schedule from the same wireless stations originally sent out every half-hour, and now at shorter intervals. By the use of special ships or "seadromes" (see below), there seems to be no reason why similar schemes should not be adopted if there should be a sufficient volume of air traffic across the Atlantic.

Having directed the aircraft to its destination there remains the difficulty of landing, a difficulty not yet wholly solved for conditions of bad visibility. With the aid of the wireless telephone a pilot can be informed of the barometric pressure on the ground and so know roughly from his own instrument his height above the aerodrome—which he has previously located by wireless. Neon beams have been found efficient for

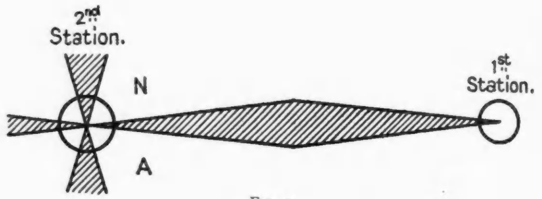


Fig. 3.
WIRELESS SIGNAL SYSTEM FOR DIRECTING AIRCRAFT.

landing in most weather conditions at Croydon aerodrome, but whether they would be equally efficacious in a Newfoundland fog is not known. As already reported in *Discovery* (December, 1929), Lieut. Doolittle, working for the Daniel Guggenheim Fund for the Promotion of Aeronautics, has made successful blind flights to and from a given aerodrome using a very sensitive altimeter; but it seems doubtful whether this would have value for use after a transatlantic crossing. A wireless "marker beacon" seems more promising, and with its aid the crossing of a definite vertical plane can be registered or flight made down a definite "wireless lane" straight on to an aerodrome or to a mooring mast.

From what has been said the reader will have realized that in most conditions of weather the transatlantic route is both possible and feasible for lighter- and heavier-than-air craft. There remains the question of ground organization. The experience with mooring masts has already shown that they are a practical proposition for airships, since R. 100 and R. 101 have been moored out at Cardington, Bedford, for long periods under all types of weather. Such a mast has already been erected and used at St. Hubert airport, Montreal, for the flight of R. 100, and it enables passengers and goods to be taken by a lift from the ground to and from the top of the mast and thus into the airship. Arrangements for refuelling and taking on of ballast are also made via the mast. In fact, the airship problem appears to be on a satisfactory basis.

The ground organization for dynamic craft is not in such a happy position. The British Arctic air route expedition has as a consequence been sent out to carry through an investigation expected to last about two years. The route contemplated from London to

Winnipeg will be roughly as follows :—700 miles to a harbour on the coast of Sutherland or Caithness ; a lap of 300 miles over the Orkneys to Thorshaven in the north of the Faroe Islands ; 500 miles to Rejkjavik in Iceland, of which about the last 200 miles would be overland ; 300 more miles of sea separates Iceland from Greenland, where a landing might be made North of the fog belt around Newfoundland, which extends nearly to 65 °N. latitude ; an ice cap with a height of 7,000-9,000 feet separates the east from the west coast of Greenland, a distance of 450 miles to Disko Island, which has been proposed as a base ; another 400 miles, including about 200 miles across Davis Strait brings the route to a post of the Hudson Bay Company, distant 320 miles along the coast to Fort Churchill ; here there is a considerable air traffic of surveyors to and from Winnipeg. In all, the route outlined is about 4,000 miles by air from London to Winnipeg, a distance at present covered by water and rail in twelve to thirteen days. If the route is to be continued to New York, a preference might be shown for proceeding south along the Greenland coast and past Newfoundland, the route taken by the Douglas planes when they flew round the world.

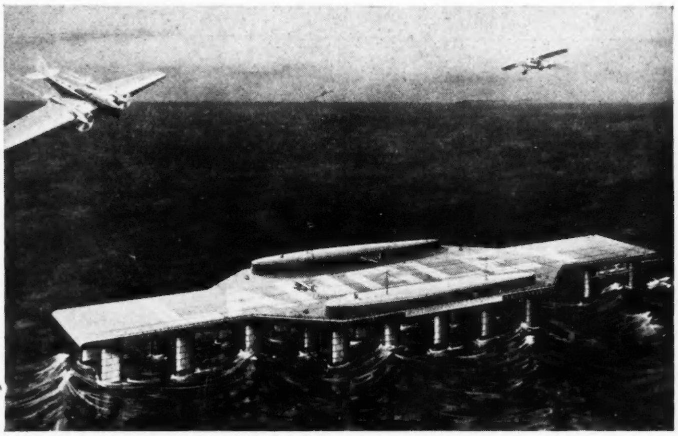


FIG. 4.
FLOATING "SEADROME" FOR OCEAN AIR ROUTES.
A scheme for the establishment of floating aerodromes is already planned, the design here illustrated being the work of Mr. Edward Armstrong.

This Arctic route does not involve a sea journey of more than 300 miles as compared with the 1,890 miles direct of the first historic flight. Even if 500 miles is the normal stage, the saving in fuel weight could be utilized for transport of passengers or goods. Kingsford Smith used in his East to West flight almost all of 450 gallons of petrol ; so that the saving of more than 2,000 lbs. weight could be devoted to a paying load. Much of this Arctic route remains unexplored, and for part thereof during the winter, the hours of daylight would be few. Nevertheless, it holds out considerable possibilities, using alternately aeroplanes, seaplanes and aeroplanes with ski undercarriages.

The alternative of the "seadrome" cannot be entirely dismissed. Aeroplanes have frequently landed on and taken off from liners at the two ends of an Atlantic voyage, so that there is no unsurmountable obstacle in aircraft using a seaborne platform. The seadromes would have a deck of (say) 1,200 feet in length and be floated about 100 feet above mean sea level, being supported by a system of anchorage consisting of weights sunk to a considerable depth. There is the question of their original cost and that of maintenance, and they would need to be kept from drifting too far from their original site. A scheme for their establishment has already been thought out in considerable detail (see Fig. 4). With their use or by a well-established Arctic route with flights not exceeding 500 miles, air transport by dynamic craft is as feasible a proposition as journey by air throughout Europe or within the United States. Aeroplanes may also be used to supplement airship traffic, and arrangements have been made in the large airships now under construction in the United States to house five aeroplanes on board.

In conclusion, we may revert once more to the airship. R. 100 has a top speed of 80 m.p.h. and has been designed to carry about 100 passengers and 10 tons of mails. With a steady head wind of 20 m.p.h. she could be expected to cross from Dublin to Newfoundland within two days, and she has already flown from the mast near Bedford to that near Montreal in just over three days. On the return journey her maximum speed would be 100 m.p.h. (instead of 60) with her mean cruising speed likewise increased to result in a great decrease in the time of travel. Moreover, the Graf Zeppelin, a smaller ship, averaged round the world a speed of 78 miles per hour. R. 101 has with its new bay a greater paying load capacity and with more powerful engines should be even a better proposition for air transport. In fact, given the necessary traffic loads, there does not seem to be any reason why Atlantic transport by airship should not become a practical proposition right away.

Open-Air Museums: A Plea for England.

By E. N. Fallaize.

Honorary Secretary, Royal Anthropological Institute.

It was announced last month that proposals for a Folk Museum are having the attention of the Government. The establishment of such an institution, designed to display the buildings of earlier periods and their contents, is a matter of urgency owing to the rapid changes taking place in the English countryside.

A CYNICAL view of the conduct of public life—at one time, perhaps, more justifiable than at the present day—looked upon a Royal Commission as a convenient method of shelving embarrassing questions in relation to which action was inexpedient or inopportune. It is devoutly to be hoped that the recommendations of the Royal Commission on our National Collections and Museums will not share the fate of the reports of so many of its predecessors.

Educative Value.

The two reports of the Museums Commission constitute one of the most important public pronouncements in relation to the advancement of scientific knowledge among the general public which has been issued for many years. For the average individual a well arranged and properly organized museum is the greatest educative medium in the subjects which come within its scope; for many it is the only means by which they are likely to obtain any acquaintance with the most recent advances in research in those branches of science which are susceptible of museum display.

Those who are best acquainted with the conditions in which our museums function are well aware how few, if any, of the recommendations of the Royal Commission are such that they can be ignored even for the time being. Where so much is urgent there is danger, especially in the present financial condition of the country, that any recommendation for a new type of institution may be set aside while the claims and needs of existing organizations have to be considered. To whatever degree this may be conceded to present circumstances, there is one suggestion which it would be unwise, even hazardous, to set aside for consideration at some future but indeterminate occasion in the hope that it will be more opportune than at the present. The Commission reports strongly in favour of the institution of a national folk museum. It realizes the urgency of the proposal; and its recommendation cannot be too emphatically endorsed.

It is a remarkable thing, but at the same time one that is not difficult to understand, that the small group of enthusiasts who in the latter part of the nineteenth century revived and organized interest in the life and thought of the peasant population of Britain—the movement which led to the foundation of the Folk-Lore Society, of which the jubilee was celebrated two years ago—should not have succeeded in arousing interest in an equal degree in the preservation and study of the humbler types of material culture in these islands. Their opportunities were far greater than ours to-day; but although a taste was stimulated among collectors and dilletanti for the more or less indiscriminate acquisition of certain classes of objects—pewters, brasses and the like, and many valuable records were made of implements and utensils of the more archaic types surviving in the remoter parts of Britain—very little was done in the way of systematic and scientific study. Yet how much might have been done can be seen from the success which some years later followed the efforts of Cecil Sharp and his colleagues in preserving folk-song and folk-dance at the moment when these forms of peasant art were in danger of complete extinction.

A Revolutionary Change.

To-day we stand in a position very different from that of the pioneers of the Folk-Lore Society. Fifty years ago, it is true, a wave of agricultural depression was driving the rural population to the towns, and the next twenty or twenty-five years saw a great increase in the introduction of machinery in substitution for manual labour and the traditional implements of agriculture. But within the present century social England, especially in the rural districts, has undergone a change which seems likely to prove as great and as revolutionary as that which took place in the two hundred years between the reigns of Edward III and Elizabeth. Since the war changes in conditions have accelerated rapidly. Facilities for rapid transport, the break-up of great estates, schemes

of public housing and small-holdings, together with changes in various directions affecting agricultural methods and policy, are rapidly and profoundly affecting the countryside, sweeping away much that was traditional and characteristic in English rural life while tending to produce one general and uniform quality and type in culture even more effectually than, as some believe, wireless broadcasting will eliminate local peculiarities of diction and pronunciation.

It would be idle to regard the social and economic changes of to-day as anything but inevitable ; and it would be equally unprofitable to adopt the attitude of the mere reactionary towards them however much the destruction of tradition they entail may be deplored. A sense of perspective in history teaches us that destruction is as essential to progress as construction. The present generation, however, has become self-conscious. It realizes more fully the consequences of its actions. If it is pulling down more rapidly than ever before in our history, it is beginning to appreciate more clearly that natural beauty and historic associations have claims which should be taken into account and at times even be allowed to outweigh economic considerations. The rapidity and nature of the changes taking place have quickened the public conscience to scrutinize closely any proposal for development in either country or town, whether put forward by public authority or private individual. The number of sites which have recently been handed over to the National Trust, the agitation to prevent the spoliation of Hadrian's Wall, and the subsequent pressure to enlarge the powers under the Acts for the Preservation of Ancient Monuments, all alike are signs of a healthy growth of public opinion on the side of the conservation of the natural beauties of the countryside and of the relics of historic Britain.

A DANISH FOLK MUSEUM.

A corner of the "Old Town" museum at Aarhus, which includes an ancient water-mill. (Photograph by courtesy of the *Museums Journal*.)

More immediately germane to the issue of a folk museum raised by the Royal Commission is the work which has been initiated by the Royal Society of Arts for the preservation of typical ancient dwellings of the humbler type in Great Britain. Anyone who has wandered in the remoter districts of England—in the Cotswolds, for instance—is well aware that nothing is more illuminating, more revelatory of the geographical, social and economic conditions of the people in the past than these ancient dwellings surviving in the natural surroundings of which they are essentially the product and where they have endured changing conditions through the ages down to the present day. Even within relatively a short distance of London can still be seen houses of wattle and daub of the plan typical in the mediaeval English village. Variations in plan, structure and material according to local conditions are vanishing rapidly under sanitary requirements and the spread of the public authorities' model dwellings. That local types which bear the record of past ages should be allowed to be swept away entirely is a calamity involving an irreparable loss to the social history of England which every effort should be made to avert.

While the preservation of a site of great natural beauty appeals to the aesthetic sense of the public, and the conservation of a monument of high antiquity, a historic building or even a peasant's cottage may appeal to its imagination, the expenditure of time and money on rescuing from destruction and oblivion the objects, of no great aesthetic merit or intrinsic value, once in everyday use among the country folk may seem nothing more than a concession to a spirit of mere antiquarianism. Exhibits shown in isolation without relation to their environment and use would only serve to confirm this view. Yet, whereas collections of the armour, dress, weapons, furniture, utensils and other domestic appliances illustrate and demonstrate more or less adequately the social life and arts of the upper classes of early England, the

arts and industries of the peasant population are poorly represented. As a record of social and economic history they are not less but even more worthy of attention. From many sources we can gather an idea of what manner of life was that of the upper classes. Of the peasants we know relatively little; and it is illuminating to see and handle the implements and utensils of which they made use in their daily lives. Some have survived practically unaltered perhaps for hundreds of years. They may in a year or two utterly vanish and be known to posterity only by hearsay or from a chance illustration. Many, indeed, have already gone. How much, indeed, would be our knowledge of English mediaeval agriculture and husbandry and of the mediaeval recreations of the people if the Bedford Psalter and Book of Hours and other illuminated manuscripts in the British Museum had not been preserved to us. Yet in a few years time, unless measures are taken very soon, we shall know less of the arts and crafts of our ancestors in the times leading up to the age of machinery than we know of the Middle Ages.

Scope and Objects.

Perhaps enough has been said to mark the serious gap in our national collections due to the absence of any representative assembly, as opposed to isolated objects, illustrative of the life and culture of the people in the past. It may be an advantage at this point to define a little more precisely what should be the scope of such a museum in space, time and character.

From the point of view of the anthropologist and the social historian, it may seem neither consistent nor convenient to make an arbitrary distinction between upper classes and peasant such as is suggested by the emphasis laid here upon peasants arts and industries. While admitting the justice of the criticism, the distinction is valid if only as a matter of practical convenience. In the recently instituted folk-galleries of the National Museum of Wales at Cardiff, it is true, a valuable exhibit of eighteenth century garments of the upper classes recently donated to the collections is shown, and in some of the large culture museums on the Continent objects illustrating the life of all grades of society are shown side by side. But in general the considerations of space must determine. In England, the culture of the upper classes of mediaeval and later England is already adequately represented in our national collections. As a matter of practical convenience, therefore, it is advisable that the museum should be confined to the folk entirely. It should not go beyond the arts and industries of the peasant and what would now be called the lower middle classes—the industrial and lower commercial groups.

As a part of a larger unit, unless economy of space is no consideration—a condition hardly probable—the collections will almost inevitably be cramped. If the full educative and scientific value of such a museum as is suggested is to be obtained, it is essential that the exhibits should be seen in their natural relation and in their proper environment. Thus in the National Museum of Wales compartments have been arranged in which are reproduced a kitchen, a bedroom or the like to represent the corresponding room in the typical Welsh house. But even at Cardiff it must be admitted that the lack of adequate space for the proper display of the exhibits is only too apparent.

Again, the question of space has a bearing upon the time factor. Period enters into the display of peasant culture almost as much as in the display of furniture or other material of upper class culture, even though in the earlier centuries phases may not be so numerous or well marked as at a later date. The number of divisions on the time scale to be represented unless space is ample may otherwise have to be determined by the amount of space available rather than by type.

On the Continent, notably in Sweden, Holland and Denmark, where special attention has been devoted to the question of folk museums, or rather museums for the exhibition of objects illustrating the national culture, a special type of museum has been evolved. These are generally known in England as "open-air" museums, though that is hardly a quite accurate designation. The essential feature of this type of museum is that the exhibits are not housed in one building, but in separate buildings, these themselves being part of the exhibit—typical dwelling houses illustrating the various types of architecture at different periods and in different areas.

The Domestic Arts.

The appropriate objects illustrating the daily life, the domestic arts and the industries of the people, are shown in each, and in some cases the attendants are dressed in the characteristic costumes—a feature of no little significance where different provinces have each their distinctive dress. It is a museum of this type which those who urge the establishment of a folk museum for England have in mind. It is proposed that dwelling houses typical of the English village and rural settlement at various periods should be erected in some conveniently accessible open space of suitable size. In each building it is contemplated that

appropriate and contemporary objects—furniture, domestic utensils and appliances should be set out in their natural relation to illustrate the domestic economy and daily life of the period. The houses, so far as possible, should be grouped in their natural relation as constituent parts of an English village, though arranged in such a way as to avoid incongruities in style and type. In this arrangement the rural industries will naturally have a place. In each household will be included the domestic arts, such as spinning and weaving, and in barns and outbuildings will be found a place for the dairy and for the appliances of agriculture—implements for digging and delving, as well as the plough, harrow, typical carts and means of transport, harness and so forth. Other village industries will each have its place, the village smithy, the weaver, basket-maker, potter, and the water-mill or windmill. Naturally a place will be found on the village green for the stocks, the pound and the village pond, and even perhaps for the church. Beside the evidences of the orthodox beliefs of the church a place will be found for less recognized cults, charms, and amulets, as well as the corn dolly, the garland of May Day or of the local holy well, the Grotto, or the Shrine with the Child in the Manger of the Christmas celebration. The Maypole will be a natural centre for the celebration of village dances and festivals which might be arranged for special occasions with the co-operation of folk-dance societies.

A GARDEN EXHIBIT.
Another view of the Aarhus museum, showing the inner garden court of a patrician residence.

Although it may be regarded as the function of the local museum to preserve the record of local industries and distinctively local types of exhibit, yet many of such local particularities are of sufficient importance to demand representation in a national museum. A central museum which sets out to be representative of the national culture cannot afford to neglect such specialized industries as the wood turning or the cottage-lace industries of Buckinghamshire, the iron work of Sussex, or the specialized cultures which developed in the great sheep-breeding areas such as the Cotswolds and the North.

It may be a matter of convenience that a time limit should be set to the scope of such a museum. A not inappropriate starting point might well be the end of the Roman occupation, but if space allows a series of reconstructions beginning with a lake dwelling, or even a palaeolithic rock shelter or cave dwelling, and leading through neolithic bronze and iron ages, would obviously be of the highest educative value. From that point of view the more complete the series, the greater its interest to the general public.

Such in brief and inadequate outline is a scheme upon which an open-air folk museum might be established. Since the installation of the folk-galleries in the National Museum of Wales, England alone in the British Isles has no collection exhibiting a general view of the past culture of its people. It should hardly be necessary to argue the desirability of its establishment when once the lack has been pointed out. Nor should it be necessary to meet opposition on the ground of the removal of the peasant's dwelling from its natural setting. Unfortunately, it is probable that too many buildings will be available for its use. The museum will save from destruction buildings which otherwise would disappear at the hands of the house-breaker in carrying out schemes of rural improvement. Of the objects which will be housed in the buildings, the supply is becoming regrettably smaller day by day. Yet in agricultural areas many obsolete implements have been preserved by older people who remember their use when they were young. It is perhaps not too late to appeal for the preservation of such objects in a museum rather than that they should be thrown aside as rubbish to decay when those who value them have gone.

Finally, there are two points upon which it is necessary to touch—that of a site for the museum and its cost. As regards a site, it is clear that such a museum must be centrally situated and must either be in or easily accessible from London. To set out such a museum adequately and without such over-crowding as would defeat its object, a space of fifteen to eighteen acres would be required.

A notice appeared in the *Daily Telegraph* of 12th August that Mr. Lansbury had announced the appointment of a Committee representing the Board of Education and the Office of Works to consider the question of the establishment of such a museum, and a promise of £50,000 towards the cost. The terms of this welcome announcement suggest that the land in Regent's Park now held by the Royal Botanic Society under a lease which expires in 1932 may be considered as a possible site. This was one of two alternatives recommended by the Royal Commission, of which the suitability has been strongly urged upon the Government by representatives of the Committee appointed by the Council of the Royal Anthropological Institute with the object of securing the establishment of an open-air folk museum for England.

Health in Engineering Works.

By C. S. Myers, C.B.E., F.R.S.

The subject of this article, contributed by the Director of the National Institute of Industrial Psychology, will be discussed by the British Association (Sections G and I) on 5th September.

THE problem of health in engineering works is approached by the industrial psychologist from quite a special aspect. For him health means primarily and fundamentally health of the mind, health of the nervous system. He regards a disordered nervous system as mainly and ultimately responsible for most of the bodily disorders of everyday life. Disease sets in, micro-organisms get their start when the organism on which they prey is "run down"; and nothing contributes more to this condition than nervous overstrain. The industrial psychologist therefore attends first to whatever causes undue strain or discord in mental and nervous processes. He regards worry as responsible for a multitude of bodily "sins." Even minute causes of irritation, when experienced many times daily, result in serious consequences.

One of the most common causes of needless mental strain is the worker's unsuitability for the work. His unsuitability may be due to lack of appropriate mental ability on the one hand, or to lack of appropriate temperament, on the other. There are some workers who enjoy repetitive work, others who abhor it, and some who prefer positions of responsibility while others dislike them. The remedy clearly lies in a more careful selection of employees, having regard to their mental abilities and temperamental qualities and to the requirements for success in the work on which they are to be engaged. With this object the industrial psychologist introduces not only vocational tests but also improvements in the interviewing of candidates in engineering works. By these means, as the director of one engineering firm attests, "we have definitely proved that the test gives us within an hour a measure of the (apprentice) boy's suitability, which it would take three to six months to obtain in the works under the control of a foreman."

Recent investigations, notably by Mr. Eric Farmer of the Industrial Health Research Board, make it probable that certain tests, indicative of engineering efficiency, are at the same time useful in eliminating those workers who are especially prone to accidents. Accidents are no longer regarded as "accidental." They are not equally spread over individuals throughout the community. Some workers are more prone to them than others, and are thus a menace not only to their own health but to that of their fellows. Here, again, is an aspect of the preservation of health in engineering works which appeals especially to the industrial psychologist.

In certain cases monotony may be combatted by change of work, and interest increased by the introduction of more appropriate incentives. Reduction of monotony and increase in interest cannot fail to improve the general health of the average worker. Undue strain may also arise from defective illumination and ventilation or from exposure to high temperatures. Much can be done in these directions to improve resulting health in engineering works. Their importance is generally neglected. So, too, is the study of the best posture and movements of the worker, the best arrangements of his materials, and the best designing of the machines and implements which he has to use, in relation to his physiological requirements.

The results of all these causes of needless strain are that the worker has to put undue effort into his work and to worry unduly over his working conditions. Whether owing to these causes or to resentment against often remediable industrial relations, his "nerves" get on edge, he becomes liable to waves of uncontrollable emotion, and he tends to become neurasthenic or psycho-neurotic. Under these conditions, bodily disorders develop—disorders of digestion, of circulation, etc. And thus are sown the seeds of more serious organic diseases.

Artificial Swarming of White Ants.

By R. A. J. Maguire.

In many parts of Tanganyika Territory the white ant is highly relished by the natives as a food. The author reveals the surprising fact that, throughout the dry season, swarms are produced on a large scale by artificial means, so that the natives may enjoy this delicacy when it would normally be " out of season."

We, in Africa, are so accustomed to the monotonous sequence of termite hills, scattered about any normal landscape, that the marvels taking place within these hills seldom occur to us. Sometimes, it becomes necessary to attempt the destruction of an ant-hill which interferes with the making of a road or the ploughing of a stretch of ground. The hunt for the Queen within the recesses of the vast organization which is a termitary is contested so viciously by her gallant soldiers that the permanent removal of an ant-hill is no simple matter. After hours of patient digging, the labour gang may be successful. The spoils of war are brought to the White Man. The Headman's hand is outstretched, a torpid and hideous mass of royalty lying in the upturned palm, blood starting from the countless tiny wounds inflicted in every finger by the brave defenders. The Queen is well served.

Workers and Soldiers.

Nothing found in the literature of the grotesque even remotely approaches a conception of the white ant colony. Its tortuous galleries teem with blind, patient workers, born to toil and knowing no other state. Its entrances and exits are guarded by another caste, the soldier ants. Helpless instruments of aggression, unable even to feed themselves owing to the crushing weight of the enormous, armoured mandibles which are their weapons of attack, exceeding in weight the rest of their bodies, they are perpetually under arms. Hidden in the core of this pullulating mass, guarded by her soldiers and fed by her subjects, dwells the Queen. An inert creature, her organs bedded in a mass of fat, she lays from ten to thirty million eggs in a year. Being incapable of movement, she can never leave her vaulted chamber, but eats and lays incessantly. The King ant, royal neither in aspect nor in habit, is an unprepossessing under-sized creature, who spends most of his life hiding beneath his partner's ample stomach !

In this article, it is my intention to deal briefly with one aspect of the subject of termites in general—the swarming. M. Maurice Maeterlinck, in his book " The Life of the White Ant," has said that the swarming takes place, normally, at the end of the equatorial summer ; that is to say, at the beginning of the rainy season. Those qualified to speak with authority on the subject agree with him. I do not question for a moment the accuracy of this statement, so far as it relates to the normal swarming time of a white ant colony.

On the coast of Tanganyika Territory, the fertile winged males and females, later referred to merely as " fertiles," would seem to leave the termitary at the beginning of the " small," or first, rains. On many occasions I have been driven from my reading-lamp by the countless thousands of these insects, whose attraction to the light has resulted in heaps of frail wings and crawling bodies on my table, on the floor, on every square inch of space surrounding the lamp for many yards. These fertiles, similar in all respects to their industrious brethren within the termitary, save that they have been equipped with frail, smoke-coloured wings to aid them in their great quest, venture forth at the appointed time to found a new colony. The mortality among them is appalling. One male and one female, met in a suitable spot, can initiate a new termitary in a very short time, but in the world of the white ant it is seldom indeed that the time and the place and the loved one are all together.

An Awesome Sight.

The swarming is an awesome sight. I cannot do better than quote M. Maeterlinck. " . . . A spectacle is seen in comparison with which the swarming of the bees becomes insignificant. From the huge building, be it stack or pyramid or fortress, often, when there is an agglomeration of cities, from an area of hundreds of acres, there rises, as from an over-charged, bursting cauldron, pouring from every chink, every crevice, a cloud of vapour formed by millions of wings mounting to the blue, in the doubtful and nearly always frustrate search for love. Like all else that is dream and illusion, the splendid vision lasts but a moment, the cloud falls heavily to the ground, bestrewing it with wreckage ; the festival is over, love has betrayed its promise and death takes

its place." The insects, birds and animals (and the humans) who relish the succulent bodies of the fallen then flock to this "Golgotha," led by the uncanny instinct which tells them of the feast in store.

In Uganda, the swarming is eagerly awaited, for the white ant is much prized as a delicacy by the natives. The same may be said of the Tanganyika natives in general, though there are certain areas in which the white ant is held in particular esteem as a food, and others in which the eating of the termite connotes social inferiority. In some parts of the country inhabited by natives who eat the white ant a remarkable custom prevails. Throughout the dry season, swarms of white ants are produced by artificial means. The method employed in so doing is ingenious. The natives, who seem to have been acquainted with the necessary procedure from time immemorial, are thereby enabled to enjoy their favourite delicacy at all times of the year.

I shall describe the procedure, which is illustrated by photographs, but before doing so it may be well to say that it seems possible to bring about swarming at any time or season, excluding neither the height of the drought nor the period immediately following the rains, when every termitary has produced its natural swarm. Further, an artificial swarming from any given termitary does not seem materially to affect the annual natural swarming from that termitary. No diminution in the number of fertiles would seem to be apparent, although it is, of course, impossible to speak definitely when such vast hordes are involved.

Some Questions.

The observer is immediately struck by the following questions: Do *all* the fertiles participate in the natural swarming, or do a proportion of them remain in the termitary all the year round? Alternatively, does the established fact that an artificial swarming in the dry season can be followed by the natural swarming at the beginning of the rains mean that the patient, industrious colony, aware in some subtle way that it has been tricked, immediately sets to work to produce fresh legions of fertiles, to take part in the natural swarming yet to come? It is a matter which I have not succeeded in elucidating to my own satisfaction. People who have studied the ways of white ants more deeply than I have may hold definite theories on the point.

The following is the procedure adopted by the natives I have seen at work. They are the *Bazinza*, the indigenous inhabitants of the area on the south-western coast of lake Victoria Nyanza. I have seen an artificial swarming produced many times, and the performance in no case varied in essentials. The photographs were all taken on the same day, in the same place. The date was early in September, two months before the normal breaking of the rains. I have seen swarms induced in the same area in the months of June, July and August, but September has been selected in the present instance as it is, normally, the most arid month in these latitudes.

Description of Photographs.

A low, mound-like termitary was selected, and the ground above it cleared of leaves, grass and debris (Fig. 1). Branches from the surrounding bushes were then cut and stacked as shown over the termitary. The dark spots in the shade of the branches are fresh leaves, placed over the mouths of the galleries leading into the heart of the termitary in order to exclude the light. The first photograph was taken at 10 a.m. Fig. 2 shows the building of the hut in progress. The native in the foreground is arranging the leaves on the inner side. It is important that the finished structure should be free from chinks, as its object is to delude the termites into the belief that the skies are overcast and the rains are about to fall. The second photograph was taken at 11 a.m. Fig. 3, photographed at 11.15 a.m., shows the finishing touches. A quarter of an hour later the building was complete (Fig. 4). The door shown is for purposes which will be apparent later. It is thickly surrounded by leaves, so that the light within the building is dim.

At 12 noon the door was held to be too small, and after discussion it was enlarged (Fig. 5). The central figure has a calabash in his left hand, from which he is preparing to dash water over the ground beneath the shade of the leaves. The man on the right supports the water-jar. The seated individual has a short, stout stick in either hand. These sticks were cut on the spot. With them, he is preparing to beat on a third stick which has been laid on the ground near the door. Fig. 6 shows the commencement of the beating, at 12.15 p.m. The two sticks seen in motion, when beaten on the third set flat on the ground, produce a hard, drumming noise, not unlike a xylophone. At frequent intervals, water from the jar seen on the right is dashed over the termitary in the dimness under the shelter of the leaves. This water is supposed to represent rain, and the continuous vibration produced beneath by the incessant drumming of the sticks is intended to simulate thunder, or the continued fall of heavy raindrops. At 2.30 p.m. the first fertiles began to appear above the ground (Fig. 7), pushing aside the leaves placed over the exits (see Fig. 1). A shallow trench had just been dug at the door by

AFRICAN NATIVES PRODUCING SWARMS OF WHITE ANTS BY ARTIFICIAL MEANS.

Details are described on the opposite page.

the man in the picture. Into this trench the fertiles are supposed to fall. A few can be seen, and there is a trail of cast-off, broken wings, leading up to the lip of the trench, left by the fertiles as they made unsteadily for the light. The stick-wielder, not seen in this picture, still continues to beat, but now a little further away and without his former intensity. He plied his sticks from 12.15 to 2.30, without pause.

The swarm is seen in progress in Fig. 8. This photograph was taken at 2.45 p.m. If it is carefully studied, fertiles can be seen almost everywhere. There is one, with wings spread, crawling up a twig in the centre of the doorway. Another, wings folded, is on the lip of the trench, which by this time is half full. Others can be seen in the foreground and within the shade of the leaves. A piece of banana-leaf has been placed on the struggling masses in the trench in order to prevent their escape. By 3.20 p.m. the swarm was over (Fig. 9). Several thousands of the captured and moribund fertiles are seen in a folded banana-leaf.

The natives pound the tender bodies into a paste. This paste is generally fried and eaten as a flavouring to grain or meat. Sometimes, it is devoured by itself. The wings are removed before pounding, as a general rule. Occasionally, the paste is eaten raw. It is highly esteemed as a delicacy among a people normally too indolent to take the trouble involved by the elaborate preparations illustrated.

Science in the Tobacco Industry.

By M. Nierenstein, D.Sc., Ph.D.

Lecturer in Bio-chemistry in the University of Bristol.

Thousands of smokers will be interested to read of the research that is constantly being made on tobacco. Many facts about this popular plant have yet to be discovered. British Association members will have the opportunity of seeing the investigations at first hand during their visit to Bristol.

It is not generally realized that the tobacco plant is grown in almost every country in the world. In many countries the locally grown and manufactured article is the one which is most largely smoked, but the introduction of the Virginia cigarette by commercial enterprise has met with great success. Although the cigarette of unmixed Virginia leaf (made, that is to say, from leaf grown in Virginia and in the adjacent states of North and South Carolina) is far and away the most popular in this country, this is not the case in the United States. The popular cigarettes there are blends of Virginia with Turkish, or with a variety known as Burley which is mainly grown in Kentucky, or with both. The attempts by Colonial and British planters to grow tobacco in Nyasaland and Rhodesia have been very successful, and some of the difficulties at first encountered have yielded to careful experimentation; the influence of such factors as latitude and climate are gradually becoming understood. A large measure of success has already been achieved in the direction of producing tobacco with a similar character and flavour to those possessed by the leaf grown in Virginia and the Carolinas, and the tobacco has, in addition, a distinctive character of its own.

While the bulk of the tobacco imported into this country comes therefore from Virginia (in the wide sense), tobacco is also brought here from many other countries, to be used for special purposes such as blending into smoking mixtures, and for the manufacture of cigars. Wherever tobacco is grown, with few exceptions, there will be found established experiment stations. These are staffed, either by Government or by business enterprise, with trained workers devoted to the problems of producing more and better tobacco, and to warfare against the many enemies of this highly prized plant. The research work which is carried out at these experiment stations is usually published, and is made use of by workers in other parts of the world.

It should also be said that a very considerable quantity of tobacco still comes from the more western states of Kentucky and Tennessee. The soil there is heavier, a different type of leaf is grown, the curing process is different from that practised in Virginia, and the resultant leaf is mainly employed in the manufacture of pipe tobaccos—Shag, Roll and Cavendish. A certain amount of tobacco of this type is also grown in Canada, and some of it finds its way to the British market.

As tobacco is not grown, except experimentally in England, we must turn to the country of origin to ascertain in what way science has been helpful to the grower. The literature of the subject is now very voluminous. The yield of tobacco in the United

States last year was estimated to be 1,501,000,000 lbs., and during the same twelve months 205,250,000 lbs. were exported to this country. The crop is therefore one of prime importance, and there is a special department for the "Study of Tobacco and Plant Nutrition" in connexion with the United States Department of Agriculture. Farmers' bulletins, dealing in a simple manner with the subjects of soils, seed-beds, fertilizers, pests and curing are obtainable free on application. Technical and research bulletins are issued at a nominal price and find their way to tobacco plantations in every part of the world. The results of special researches which have sometimes taken several years to carry out are published in various agricultural and scientific journals.

The importance of nitrogenous manures for a good yield, of potassium in the fertilizer for good burning quality, and of magnesium as well as calcium in the soil, have all been demonstrated. The finest cigarette tobacco in the United States is grown to a large extent on soil which is sedimentary in origin, and is best described as a light sandy loam, so that very much depends on the correct adjustment of fertilizer ingredients. It is inevitable that when land is cleared and devoted to the growth of a single kind of vegetation the balance of nature should be disturbed. Plant enemies and diseases, which would either pass unnoticed in the natural state of the land or be kept in subjection, attack the newcomer so carefully provided for them and flourish exceedingly. Eel-worms in the soil, fungoid diseases of root and stem, cut-worms and caterpillars, bacterial diseases spreading like wild-fire, and obscure virus diseases have all to be coped with, and are all receiving specialized attention. There is, moreover, in each State an agricultural experiment station where local problems receive special attention.

A New Research.

When the plants have been duly raised from selected and sterilized seed, transplanted from the seed beds to the fields, received their dosage of fertilizer, and are beginning to show signs of flowering, they are topped and the side shoots or suckers which then appear are removed. This is done for the purpose of retaining all the assimilated nourishment in the leaves which are left on the plant, and the farmer must then watch for the first signs of ripeness in the leaf. The leaves are gathered in, a few at a time from each plant, and hung in the curing barns. The next stage is a critical one, for unless the right conditions of ventilation, temperature and humidity are maintained day and night, the colour will not develop and fungous diseases may attack the dying leaves. What actually takes place during the development and fixing of the valued golden or orange yellow colour is not yet quite clear, but a research is at present in course of progress at the University of Bristol, which, it is hoped, will afford some definite information. The old belief that this colour was due to a special tobacco-tannin seems likely to disappear, and the theory that the colour is due to degradation products of chlorophyll may follow it. The ripe green tobacco leaf contains much starch, the cured leaf scarcely any, and the process of curing, although worked out empirically, would seem to be calculated to favour enzyme action to the fullest extent.

Fermentation Problems.

Before the tobacco is ready for export from America to this country, it is passed through long re-ordering or conditioning machines, being first dried and then brought to the required condition of moisture. Many years ago the foreman in charge of one of these machines was asked how he knew when he had the right temperature. He said he could tell by spitting on the steam-pipe and listening to the result! Many thousands of pounds of leaf had, however, been over-dried, and a very elementary application of science in the form of a few thermometers was sufficient to prevent any further recurrence of that trouble.

When the leaf is finally packed in the casks, which are about four feet long and four feet in diameter, it may remain for a time in store at an American port, or it may be brought over at once and lie in a bonded warehouse in this country for a period depending on the character of the leaf. Whilst in the cask a mild degree of fermentation takes place, amounting only to what is described as a sweating, but this reaction has a considerable influence on the sweetness and aroma of the leaf. The change is a subtle one, and does not seem to have been made the subject of research.

As tobacco is the product of such an endless variety of soils, climates, modes of cultivation and curing, it is natural to expect that when smoked, whether in the pipe or in any other form, the taste or aroma of the smoke will show equally great differences, and this is actually the case. It would be tedious to recite a list of all the countries and districts from which tobacco comes into this country, but the characteristics of each kind are so well marked that an expert can usually tell with the first two or three puffs whence the tobacco came which he is smoking.

The first serious attempt in this country to analyse

a range of tobaccos was made by Dr. James Bell, a former principal chemist at the Government Laboratory. His figures, which have been corroborated by many subsequent analyses, demonstrate the wide limits between which most of the constituents vary.

If the results of some recent analyses are quoted they will serve to show that this variation occurs even when specimens of the same grade of the same variety of leaf are subjected to chemical analysis.

Analysis of Cigarette Tobacco Leaf.

Inclusive of midrib, from Virginia, North Carolina and South Carolina. (Expressed on dry, sand-free basis.)

Constituent.	*Percentage.*		
Nicotine	2.05	to	3.24
Ammonia	.04	,,	.14
Amides	.84	,,	2.79
Albuminoids (excluding amides)	5.90	,,	7.89
Nitric acid	.26	,,	.58
Acetic acid (volatile acidity as)	.13	,,	.36
Fixed organic acids (as oxalic)	4.41	,,	6.1
Starch	.62	,,	2.31
Dextrose	4.8	,,	11.90
Cellulose	9.49	,,	18.09
Pentosans	3.5	,,	8.32
Crude fibre	8.28	,,	13.45
Petrol extract, free of water-soluble matter	2.5	,,	5.58
Ether extract after petrol extraction, free of water-soluble matter	.32	,,	1.26
Alcohol extract after ether and petrol extraction, free of water-soluble matter	1.32	,,	3.37
Cold water extract	45.94	,,	48.84
Ash, free of sand and carbon dioxide	7.65	,,	12.18

Analysis of Tobacco Ash.

Calculated to dry basis, free of sand, carbon, and carbon dioxide.

Constituent.	*Percentage*		
Silica	1.03	to	2.85
Ferric oxide and alumina	2.82	,,	9.24
Lime	25.80	,,	39.97
Magnesia	3.58	,,	8.99
Potash	22.29	,,	33.95
Soda, by difference	.73	,,	1.63
Sulphuric anhydride	3.94	,,	9.31
Phosphoric anhydride	4.18	,,	7.72
Chlorine	6.05	,,	26.53

The influence of the various constituents of the tobacco leaf upon the "burn" of the article has been the subject of much research from the time of Schlösing onwards. A glance at the foregoing tables will show how many constituents there are in the leaf which are liable to variation. The character of the resinous constituents has undoubtedly a good deal of subtle influence upon the products of combustion, and problems such as these are being incessantly and patiently investigated.

The constituent nicotine has for a long time been of absorbing interest. Accompanied by two or three other alkaloids in small proportions, it is the characteristic feature of the tobacco plant, and has so far never been found elsewhere in nature. The physiological effects of smoking are mainly (but not entirely) due to the presence of this compound, the purpose of which in the economy of the tobacco plant is not yet definitely known, although it appears to afford an outlet for waste nitrogenous matter. It is rather curious that the proportion in which this potent body is present is not taken into account as an important factor in the actual manufacture of smoking tobaccos, but the manufacturer knows that the *strength* of a tobacco is not dependent upon the nicotine alone. The attempts to place de-nicotinized tobaccos on the market have been far from encouraging in this country.

In 1844 Mr. R. Phillips, a chemist of forty years' experience, was giving evidence before a Select Committee on the tobacco trade, and was asked whether nicotine was accessible in any distinct shape—had any quantity been collected together so as to be subjected to a chemical test? He replied that he had never seen it, nor seen anyone else who had seen it. Since that day hundreds of tons of nicotine have been produced in this country alone, to say nothing of America or the Continent, so that this article which is invaluable as an insecticide has now been placed within the reach of fruit and hop growers. New processes for its production and estimation are of almost monthly appearance, and it has been synthesi ed by more than one method, but so long as it can be produced from tobacco waste upon which the customs duty has been refunded it is not likely to fear competition with a synthetic compound.

Legal Requirements.

Before the introduction of cigarettes less than one per cent of the tobacco imported was returned to the customs for a refund of the duty, but the necessity arose for removing stalks, dust and sand, and at the present time something like ten per cent of the tobacco received into the factories is not utilized in manufacture. The refunding of the customs duty originally paid is contingent upon analyses of samples made at the Government Laboratory, a "Standard" for the composition of tobacco having been instituted in 1863 and revised in 1883 and again in 1904. This was necessary to ensure that Drawback of duty should not be paid on extraneous matter. The factory chemist controls the mixing of the refuse so as to ensure uniformity, and checks the analyses made by the Government chemist.

The manufacture of tobacco for home consumption is controlled by an Act of Parliament passed in 1842, to which various amendments of a limiting character have been added from time to time. For a brief and merry period after the repeal in 1840 of the Act imposing an Excise Survey, the manufacturer was prohibited from using herbs and the leaves of trees, but he made considerable use of sugar and many other ingredients, " by which evil practice the Revenue was damnified," and he was then limited to water only, with a few minor concessions in special cases. In order to make sure that the provisions of the Act were being carried out a chemical laboratory was established by the Board of Inland Revenue, ultimately becoming, together with the Customs Laboratory, the present Government Laboratory.

There is a tradition in the tobacco trade that in the old days the manufacturer tested for moisture by flinging a handful of shag against a wall. If it adhered he knew that it contained a satisfactory amount of moisture! Laboratories were not introduced into tobacco factories before 1887, in which year the amount of moisture which might be present in tobacco offered for sale was strictly limited. The moisture testing-rooms which were then installed have developed into the chemical laboratories which are now to be found in most of the large factories.

In the laboratory of the Imperial Tobacco Company* there hangs a portrait of the great French chemist, Lavoisier, for we are told in Carlyle's " French Revolution " that this eminent chemist was guillotined for putting water in the people's tobacco. The penalty in this country is not so severe, but every tobacco factory is visited once a week or oftener by officers of the Excise who are authorized to take samples before even the manufacturer has had time to test them, and if any sample, however small, is found to contain moisture in excess of the legal limit the Commissioners of Excise have the power of instituting proceedings before a Court of Summary Jurisdiction.

1,000,000 Tests.

The testing for moisture is now an essential step in the manufacture of tobacco. The dry leaf is tested upon arrival at the factory, and the amount of water which must be added to render it pliable is calculated accordingly. Uniformity of condition could not be ensured unless this control by testing were exercised to the fullest extent. Then again the tobacco leaf, owing to its high content of salts, especially potassium compounds, is extraordinarily sensitive to changes of atmospheric humidity, and this has led in recent years to much development in the matter of air-conditioning. As an instance of the care with which the manufacturer must proceed in order to ensure uniformity in his products, it may be mentioned that the Imperial Tobacco Company alone makes over a million moisture tests in the course of the year.

One of the latest applications of modern science in connexion with tobacco is reported in some work done by Goodspeed and Olson in the University of California. These experimenters have exposed the sex-cells of the tobacco plant to the action of X-rays, and from the seed so produced they have raised an extraordinary collection of varieties. Plants of a character never before seen have been raised from what has been regarded as a stable type, and it now remains to be seen whether those variations which appear to be valuable can be fixed and made self-reproductive.

* The writer is indebted to members of the Company's scientific staff for assistance in compiling this article.

British University To-day.

(Continued from page 300.)

Among the university societies one which is out of the common is the Spelaeological Society, founded about 1919 to explore the caves of the Mendips. In Aveline's Hole the Society found broad-headed skulls mixed with long-headed ones in clearly late Palaeolithic times, the earliest known form of broad-headedness in England. By invitation of the Royal Irish Academy the Society has explored a cave at Kilgreany. For the first time the presence of man in late Pleistocene times has been proved, and a species of vole—a field-vole, *microtus arvalis*—new to Ireland has been discovered.

The Union buildings are the home of the University Appointments Board as well as of undergraduate societies. The secretary of the Board, being also secretary of the Union, is brought into close touch during their undergraduate years with those who may on graduation apply for his advice and assistance, and has thus every opportunity of estimating their abilities and their suitability for vacancies which may occur. It is interesting to notice that an increasing number of graduates find, and indeed seek, employment in the Dominions and Colonies and in foreign countries. For some years after the war parents, naturally enough, were inclined to discourage their sons and daughters from going abroad. That period has now past, and our young graduates are off to Canada and South Africa, to Mexico and Singapore and the Sudan, the women no less keen than the men to see the world. This is one of the healthiest signs of the times; the spirit of the old Merchant Venturers is still alive in Bristol.

Book Reviews.

Crucibles : the Lives and Achievements of the Great Chemists. By BERNARD JAFFE. (New York : Simon and Schuster. $5.00.).

This is a very noteworthy book. It appears as "the winner of the ($7,500) Francis Bacon award for the humanizing of knowledge sponsored by the Forum Magazine and Simon and Schuster" among some hundreds of competitors. It is described by the late Dr. Slosson, who was one of the judges, as "the history of chemistry, told in biographies, brilliantly written, full of interesting personalities, and with the necessary scientific explanation deftly worked in with as few repellent terms as possible." Dr. Slosson, whose regretted death has deprived America of a real pioneer in the popularization of science, the founder of its "science news service," was highly esteemed by all those in England who knew him and his work. He was not at heart a sensationalist ; he had a deep and fervent love for science and a belief in the greatness of its mission, but at the same time he understood very clearly the limitations of the public to whom he addressed himself, and he gave sanction to a style which, while doubtless suitable in America, has peculiarities that make it not altogether acceptable to the British public. English men of science are perhaps apt to be rather merciless towards this brand of popular science, so different from the traditions of Tyndall and Ray Lankester of the past, and unlike, for example, the Bragg and Arthur Thomson of to-day.

This allusion to Dr. Slosson is made not merely to give weight to his opinion, and to pay incidentally a tribute to his services, but to prepare the reader of Mr. Jaffe's book for an element of its style, which has to be accepted much as one accepts a foreign idiom. That being done, it will be recognized at once that this is really a serious piece of scientific authorship, carried through after long preparation and great labour, by an extraordinarily well equipped and talented writer. The bibliography of "Sources," that is appended, shows the wide range of scientific literature which has been assimilated and very skilfully drawn upon by the author, to make something like a connected narrative of chemical discovery. Each chapter is headed with a name, and a beginning is made by depicting the state of the chemical or alchemical mind and doings just before the time of Paracelsus. For this purpose the author has chosen to give a summary of the life of Bernard Trevisan (1406-1490), as recorded in the Nürnberg work published by Casper Horn in 1749, containing the writings and autobiography of Trevisan. The picture is lively and entertaining and serves its purpose, but it seems a little eccentric to put as the first figure, in sequence with fifteen great personalities, who have all given a notable turn to real scientific history, one whose very name, to say nothing of his performances, is hardly known to chemists, and counts for nothing, or next to nothing at all, in chemical history.

Following upon Trevisan, we have standing at the head of chapters the names of Priestley, Cavendish, Lavoisier, Dalton, Berzelius, Avagadro, Wöhler, Mendeleeff, Arrhenius, Madame Curie, J. J. Thomson, Moseley, Langmuir. This selection may seem in some respects arbitrary, but it very well suits the author's plan of exposition and it will be found that, with few exceptions, substantial justice has been done to other discoverers whose names might on another scheme have taken their place at the head of chapters. The most noteworthy instance to excite regret is probably that of Boyle. It seems hardly fair that anyone proceeding to learn something of the history of chemistry should not have impressed on him clearly the profound influence exerted by the work and writings of the man whose time-honoured title, "the Father of Scientific Chemistry," surely remains undisputed.

As already indicated, Mr. Jaffe's book is an exposition of chemical discovery interwoven with biography, tracing the history of chemical discovery and chemical philosophy from the beginning of the phlogistic period to the present day. Historical sequence is not always strictly followed, but where it is departed from there usually seems to be justification. Indeed, in this connexion the author shows a good deal of ingenuity.

It is inevitable that in executing so large a task there should be some mistakes. In the history of chemistry before the eighteenth century, and in the very latest period which has brought the science into the meshes of wave mechanics, the present reviewer has no pretensions to expert knowledge. There may, for all he knows, be statements in these regions that will bring down the hand of correction, but over that range of chemical history with which he is tolerably familiar the book gives no serious ground for complaint. Some errors and disputable statements have been observed, but they are of no great importance and need not be recorded in this notice.

As an attempt at popularization the book has great merit, though in places the exposition seems to suffer by the ejaculatory and sometimes almost rapturous style. This is most noticeable towards the end, where the laudatory terms applied to the living make one feel for their sakes a little uncomfortable. It is very difficult for a chemist to foretell how far a perusal of the book will give an understanding of basic chemical ideas to those who have never worked in a laboratory. Though there is no explicit statement on the subject, the readers in view are presumably "the intelligent public," which must be taken to mean intelligent people who have had no training in the practice of science. The difficulty of dealing with such readers has been recently discussed elsewhere by the present reviewer, and reference was made in the editorial column of this journal to his insistence on the difference of "knowing" science and "knowing about" it. Whether or not the book may succeed beyond its forerunners with general readers, it will be well worth reading by students of chemistry at an early stage of their studies. In spite of the element of style already referred to, there is a real feeling throughout for the glory of scientific conquests and for disinterested and self-sacrificing effort in what is called sedately by the Royal Society "the improvement of natural knowledge."

ARTHUR SMITHELLS.

The Use of the Microscope. By JOHN BELLING. (McGraw-Hill. 20s.).

This is described as a hand-book for routine and research work. The author holds the position of cytologist at the Carnegie Institution of Washington, and is able to write from many years of experience in the practical use of the microscope. Mr. Belling seems to have made a particularly close study of the numerous adjustments and variations of method which play so important a part in the perfection of the image in the microscope. These methods are discussed and criticized at some length. The book contains twenty-seven chapters, the first sixteen of which are devoted to a detailed description of the instrument and its parts. The author then describes methods of testing, rules for high-power and routine microscopy,

a hundred microscopical objects of biological interest, and other important aspects of the subject.

In an interesting chapter the author outlines two important discoveries made with the microscope. Both were made with the achromatic type of instrument, and Mr. Belling suggests that they may be placed " among the few greatest discoveries." The first was the cell theory of living organisms. " Every cell from a cell " was, and still is, the foundation of ontogeny and phylogeny. This discovery was made from microscopical observations of plants and from a study of animal tissues. The important deductions are that each plant and animal normally comes from a single cell; that all the different tissues are usually formed by permanent changes occurring in certain of the cell progeny of the original cell; and that the faculty of reproduction (and the partial reproduction called " regeneration ") shows, in the tissues of plants and animals, all grades, from complete reproduction by any cell, to the absence of any cell division at all. These more or less permanent changes in the cells, as they multiply to build up the tissues, are almost without any explanation to-day, and remain a challenge to investigators.

The second great microscopical discovery, the author thinks, was the chromosome theory of inheritance.

Mr. Belling predicts that further progress with the microscope will come from a triple combination. The quickest method of fixing must be combined with the sharpest staining process, and also with the most correct microscopy. Colours of stains, he points out, should be adapted to the yellow-green (or other) screens in use. Photographs taken with the microscope will doubtless be sharp, if the laws of optics are obeyed as well as they are in the taking of motion-picture photographs. Such sharp photographs should lead to valuable discoveries.

This book will, perhaps, appeal most to students of microscopy, whom the author has obviously borne most in mind. The questions at the end of the book cover almost every aspect of the subject, and the practical exercises are also a valuable addition.

Captain James Cook, R.N.: A Hundred and Fifty Years After. By SIR JOSEPH CARRUTHERS, K.C.M.G., LL.D. (John Murray. 7*s*. 6*d*.).

In this indignant little book the author deplores the lack of veneration among " our young people nowadays " for the memory of the founder of Australia. " To permit the memory of Captain Cook to remain under a cloud," he writes, " is to contribute towards a slackness in that spirit of veneration which is an essential of the higher character of our race." It is surprising to know, in the first place, that the founder of Australia has ceased to be venerated and, secondly, that his memory is under a cloud. With almost fanatical reverence, Sir Joseph refutes " the untruths and misconceptions which have proved harmful and unjust to the reputation of the great explorer," and produces testimony from native Hawaiian sources as well as from authentic records of English eye-witnesses.

It seems doubtful, however, whether the book will prove successful in inspiring the spirit of veneration. It contains little of scientific interest that is not already known, the literary style is tedious, and there is a strong suspicion of bias. Sir Joseph devotes considerable space to an analysis of early criticisms of the explorer, launched by a variety of writers. A little more modesty might, perhaps, have been looked for in the author's preface, in which he sets out at length his own part in effecting a more adequate public recognition of the qualities of Captain Cook.

Interviewing Wild Animals. By F. RATCLIFFE HOLMES. (Stanley Martin & Co. 3*s*. 6*d*.).

The author of this book is one of the new and more attractive type of sportsman who prefers to shoot his game with the camera rather than the gun. He tells us here how his films were obtained, and the seemingly unsurmountable difficulties which he overcame in obtaining them, though he does not conceal the fact that these difficulties sometimes overcame him. As Colonel H. Marshall Hole points out in a Foreword, the wild life of Africa, which has suffered so greatly in the past from indiscriminate and unnecessary slaughter, has found a new ally in the cinematograph. There is more interest and instruction in one living picture of animals in their natural haunts than in a hundred trophies.

It is difficult to do justice in a short review to a book so thronged with incident and observation. Its dangers and thrills include encounters with lion, rhinoceros, leopard, elephant and buffalo. Of these animals Mr. Holmes considers the buffalo the most dangerous, for it is " inspired by a downright hate of humanity."

One of the most interesting chapters is entitled " The Way of the Wild." The author concludes that the popular estimate of the comparative values and uses of animals' senses of sight, hearing and smell is erroneous. His observations have proved to him that " the sense of smell alone conveys definite and detailed knowledge." Animals did not associate the noise of the cine-camera with human beings, and (unlike some British birds) failed to see the lens. Their eyesight, he says, can register *movement*, even at a great distance, but for analytical purposes, such as looking into bushes concealing the camera and its attendants, it is greatly inferior to ours.

Mr. Holmes also thinks that wild animals possess a telepathic sense which warns them of danger: it is latent in us all, but exists in them in a more highly developed form. In another chapter, " Can Animals Talk? " he develops this theory further, and relates some very curious experiences which suggest that wild animals possess something which is at least equivalent to the power of speech, by which they can convey definite information to each other.

There are some rather pungent comments upon scientists who would make protective colouration in nature explain too much. " The real question," he says, " is not whether animals so quaintly or curiously marked as the zebra, giraffe, and leopard are more difficult to see against a back-ground which *happens* to be similar to their own colour scheme, but whether they are camouflaged amidst the surroundings in which they are most commonly to be found." He concludes that they are not, and gives his reasons. He admits that nature has afforded special protection to *e.g.*, caddis worms, by imitative colouration, but points out that they are only to be found amidst surroundings which assist the camouflage. This seems to be much the same conclusion as that which Mr. Pycraft adopts in " Camouflage in Nature," when he says " protective colouration would not be of the slightest service unless ancillary to behaviour which must adjust itself to the colouration."

Besides animal lore, the book contains much fascinating information about native customs and superstitions. Mr. Holmes relates one instance of native magic which is almost uncanny: he killed two wildebeestes for food, but the carcasses were a considerable distance apart, and he had not enough porters to guard them both from the vultures. His gunbearer tied certain knots in the hair of one animal, assuring him that this was a charm which would keep the vultures off. Two hours

later the wildebeeste was found intact; though the vultures were wheeling about it, none had touched it.

It is a pity that the book has no index. But it is one to read and keep.

E. W. HENDY.

Points of View. A Series of Broadcast Addresses. (Allen & Unwin. 4*s.* 6*d.*).

The addresses reproduced in this book are described as "a small instalment of an experiment in popular education," and were broadcast from London last autumn by Mr. H. G. Wells, Sir Oliver Lodge, Dean Inge, Professor J. B. S. Haldane, Sir Walford Davies, and Mr. G. Lowes Dickinson, who also contributes an introduction and a concluding summary. "Such addresses as these," writes Mr. Dickinson, "will not, of course, supersede schools and colleges, still less books; but they may reach a larger and more miscellaneous audience. They are seeds thrown out over the world at large, and their crop will help to determine its future. Public opinion is now in the making, not only in the West, but in the East, and this is one of the ways in which the important question is being put and answered: Can democracy succeed?"

Mr. Dickinson, who opens the series, commences by defining democracy: "I am a democrat; by which I mean that I believe in free and open discussion about all laws that exist, or ought to exist, and in the right of anybody and everybody to advocate their change, not by force but by persuasion."

Mr. Haldane's point of view is the most comprehensive of any of the contributors. He discusses in turn orthodox religion, education, censorship and the suppression of free thought, health and the comparative healthiness of various occupations, the birth rate, the death rate and the psychological value of marriage; and concludes with an appeal for wider educational opportunities for the children of skilled artizans. Mr. Haldane's is the point of view of the young man, and it is interesting to compare it with the views of the other contributors, the youngest of whom is twenty-seven years Mr. Haldane's senior. In criticizing the present educational system, he suggests that it is unjust to children because the majority do not get a fair chance: practically none are taught the truths of science from a human point of view. "Science teaching should begin, not with a mythical body in rest or in uniform motion, but with the human body."

Sir Oliver Lodge stresses the need for living together peaceably by common consent, and cites as an example police regulation of traffic. He makes a spirited attack upon the "old abominable motto," that if we want peace we must prepare for war, and points out the impossibility of private life under such conditions. Sir Oliver forecasts the establishment of an international parliament, "when the whole human family will govern itself by mutual agreement."

Guide to the Orchids of New South Wales. By H. M. R. RUPP, B.A. (Angus and Robertson. 7*s.* 6*d.*).

The few standard works on the Australian orchid are not readily accessible to a great number of nature lovers on account of expense, and consequently there must be many who have been deterred from studying these plants because they have been unable to find helpful books at a popular price. The author outlines the salient features of the plants and supplies a number of excellent illustrations. "The book makes no claim to be a technical handbook," which is a decided point in its favour, and the author has studiously avoided technical terms. Where he has been compelled to use scientific names, they are fully explained in a glossary. Many details have been omitted which would be considered essential in a handbook of technical descriptions because, as the author explains, to a non-botanist they are merely tiresome and confusing.

In a preface the author makes some preliminary remarks concerning the general character of the orchid which will be welcome to those whose knowledge of the flower is rudimentary. It is generally accepted that the orchid is the most highly specialized member of the kingdom of flowering plants, and an outstanding feature of its character is that, in the course of its evolution, it has developed beyond the stage of stamens and style. On the side of the column which faces the front of the flower is a sticky swelling or disk, often difficult to see but easily detected by touch, called the stigmatic plate. Above this is an oddly-shaped receptacle containing one or more little sacs of extremely fragile texture—the anthers. At a touch they break, exposing the pollen, which in most orchids is viscid, not powdery. This is the main feature which distinguishes the orchid from other flowers.

The amazing devices contrived by orchids for making this revolutionary development effective constitute a fascinating field for study, beyond our present limits. From the point of view of their habits, orchids are known technically as Epiphytes, Saprophytes and Terrestials. New South Wales has over two hundred species of orchid known to science, of which forty-three are epiphytes. The home of these flowers *par excellence* is the strip of country from the Dividing Range to the coast, most of the epiphytes being restricted to this area. Terrestials occur plentifully from the coast across the Divide to the western slopes, and extend in rapidly decreasing numbers to the western plains. Epiphytes, saprophytes and terrestials are described in detail in the succeeding chapters and many interesting illustrations are given.

Nature Rambles. Vols. III and IV. By EDWARD STEP, F.L.S. (Frederick Warne. 2*s.* 6*d.* each.).

Readers of the first two volumes in Mr. Step's interesting series will welcome the publication of Volumes III and IV, which now complete the "Come with Me" books. The series is described as an introduction to country lore, and comprises accounts of rambles in rural places in spring, summer, autumn and winter. The aim of the author is to awaken an interest in the common forms of animal and plant life, and the simple descriptions of various aspects of natural life serves as a valuable introduction to more serious study. Numerous familiar plants, insects and larger animals are discussed, but space is also devoted to a number of lesser known subjects, and illustrations have been included on a liberal scale.

While we imagine that the books are primarily intended for children, they are by no means childish, and there is no doubt that they will prove interesting and instructive to those who wish to extend their knowledge of plant and animal life and have not the leisure at their disposal in which to study the more advanced works. In Volume III the author describes summer in the pastures, along the seashore, beside the stream, on the downs and among the chalk hills. The concluding volume contains descriptions of the common in early autumn, autumn in the oakwood, in beachwood and chalk hills and among the pine trees.

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